



United States Environmental Protection Agency
New England Region
Office of Site Remediation and Restoration
One Congress Street, Boston, MA 02114-2023

Enforcement-Sensitive Information Attached

Memorandum

Date: October 29, 2002

Subject: Request for Removal Action Mohawk Tannery Site, Nashua, New Hampshire –
Action Memorandum - Non-Time-Critical Removal Action

From: Neil Handler, Remedial Project Manager
NH & RI Superfund

Thru: Michael Jasinski, Section Chief
NH & RI Superfund

Larry Brill, Branch Chief
R & RI

To: Richard Cavagnero, Acting Director
Office of Site Remediation and Restoration

I. Purpose

The purpose of this Action Memorandum is to request and document approval for the proposed Non-Time-Critical Removal Action (NTCRA) and a \$2 million exemption request described herein for the Mohawk Tannery Site (the Site) located in the City of Nashua, Hillsborough County, New Hampshire. The Removal Action is necessary to prevent, minimize, and mitigate potential threats to human health and the environment posed by a release of hazardous substances to the environment. The NTCRA would address the threats posed by a release of dioxin and other hazardous substances found at the Site by removing contaminated waste from six unlined disposal areas and transporting the waste off-site to a permitted facility for disposal. The NTCRA is consistent with the long-term remedial strategy for this Site to minimize exposure to and migration of contaminants and to restore the Site to its productive use.

The New Hampshire Department of Environmental Services (NH DES) under a Cooperative Agreement with the U.S. Environmental Protection Agency (EPA) is now in the process of conducting a Remedial Investigation (RI) to evaluate the full nature and extent of the contamination at the Site not already addressed by this NTCRA or by previously completed time-critical removal activities.

II. Site Conditions and Background

CERCLIS Identifier:	NHD981889629
Site Identifier:	017C
Category of Removal:	Non-Time-Critical
Nationally Significant/	
Precedent Setting:	No
NPL Status	Proposed on the NPL on May 11, 2000

A. Site Description

1. Background

The Mohawk Tannery Site (a.k.a. Granite State Leathers) is located at the intersection of Fairmount Street and Warsaw Avenue in Nashua, New Hampshire. The Site is the former location of a leather tanning facility that operated at the property from 1924 to 1984. The Site consists of two adjacent properties; they are a developed parcel to the north, and an undeveloped parcel to the south. Each parcel is about 15 acres. The inactive tannery facility, which is the focus of the NTCRA, is situated on the northern parcel. The tannery is bordered by the Nashua River to the west, the Fimbel Door Company to the north, and residential areas to the east and southeast. As of 1990, the total number of people living within one mile of the Site was 1,470.

Several structures used in tannery operations, as well as debris from several demolished structures, still remain at the Site. Remaining structures include: the main facility building; a smaller control building attached to the main building; and portions of the former wastewater treatment system. Although the tannery shut down in 1984, portions of the main building have since been used by the owner and several renters for storage purposes. The formerly industrial property has been re-zoned residential by the City of Nashua. Future development of the Site is very likely, given its close proximity to downtown Nashua (see attached Figure 1).

Little is known about the tannery's effluent treatment practices prior to the 1960's. In general, industry practice prior to that time did not require any treatment of wastewater prior to its discharge into nearby waterways. In the 1960's the facility began providing some treatment of wastewater prior to its discharge into the Nashua River. Two unlined lagoons were constructed along the western side of the tannery property approximately 60 feet from the Nashua River. These lagoons are located predominantly within the 100-year floodplain of the Nashua River.

Initially, treatment within the two lagoons (which are identified as Areas 1 and 2 on Figure 2) consisted of combining acid and alkaline waste streams and allowing the solids to settle out before the liquid fraction was discharged to the river. Periodically, the sludge from the two lagoons was dredged and disposed of in several other disposal areas on the property. During the 1970's, a new treatment facility was constructed at the Site and it was reported that sludge located in the vicinity of the new treatment facility was transferred to Areas 3 through 6 as identified on Figure 2. In 1980, materials including hide scraps and other miscellaneous refuse located near the main facility were excavated in preparation for construction of the control building. The excavated materials were moved to the southwest to the area identified as Area 7 on Figure 2.

During the early 1980's, dried sludge from the tannery was placed in a PVC-lined landfill on the adjacent Fimbel Door Company property (Fimbel Landfill). The Fimbel Landfill has since been capped with a low permeability cover and closed under New Hampshire State Regulations. The Fimbel Landfill was not evaluated as part of this NTCRA. A majority of the lagoons and disposal areas at the Site have been covered with varying amounts of fill material and allowed to naturally revegetate. The one exception is Area 1, an open lagoon approximately one acre in size, containing approximately 25,000 cubic yards of wet odorous waste material.

While operating, the tannery used numerous hazardous substances in the preparation and tanning of animal hides including chromium, pentachlorophenol, and 4-methylphenol. Dioxin has also been found at the Site and is believed to be a by-product associated with the use of pentachlorophenol and other chlorinated phenolic compounds for the treatment of hides. It appears that the southern undeveloped parcel has not been impacted by contamination associated with past operations and waste disposal practices at the tannery based on earlier investigations completed on behalf of the tannery owner.

EPA investigations concluded that during the time the tannery operated, hazardous substances, such as those mentioned above were discharged directly into the Nashua River and deposited into the lagoons and waste disposal areas at the Site. There are approximately 60,000 cubic yards of waste at the Site. A majority of the waste is located within the 100-year floodplain of the Nashua River. The waste has not been disposed of in a manner which would prevent human exposure nor the washout of materials in the event of a flood.

A Time-Critical Removal Action was completed by EPA at the Site in January of 2001. During this removal action, EPA characterized and shipped off-site for disposal drums and small containers containing hazardous substances, asbestos containing material, caustic wastes, and the contents of a clarifier tank. In addition, a number of gates were repaired and warning signs were posted to help further secure the Site. Additional details concerning the removal action are provided in Section B below.

2. Removal Site Evaluation

An initial characterization of subsurface conditions was performed in 1985 for the tannery owner by Goldberg-Zoino & Associates, Inc., to support redevelopment of the Site. Investigative activities completed during the initial characterization provided the first detailed information concerning the extent of contamination at the Site.

Since that time the NH DES and EPA have conducted several investigations at the Site. The investigations of the Site as well as the Nashua River completed during the late 1980's and 1990's have included a Preliminary Assessment of Mohawk Tannery in July of 1987 (EPA), a Screening Site Inspection in July of 1989 (EPA), an Expanded Site Inspection in December of 1993 (NH DES), and a Final Site Inspection Prioritization Report in November of 1996 (NH DES).

In July of 2000, EPA prepared an Approval Memorandum calling for the completion of an Engineering Evaluation/Cost Analysis (EE/CA). The purpose of the EE/CA was to further characterize the nature and extent of contamination in the unlined lagoons and disposal areas at the Site and to evaluate removal options for these materials. EPA's consultant, Tetra Tech NUS, Inc., completed the EE/CA field investigation activities during August/September of 2001. A final EE/CA was released to the public in July of 2002, and was then followed by a 30-day public comment period for EPA's recommended cleanup approach for the Site. During the comment period EPA held a public information meeting and a public hearing.

The Site was evaluated for public health implications by the Agency for Toxic Substances and Disease Registry (ATSDR) in a Public Health Assessment (August 22, 2001). ATSDR concluded that although current exposures are probably low, remediation of the Site is needed because, in the future, changes in land use or a large flood of the Nashua River could increase exposures to levels that could potentially cause adverse health effects.

3. Physical Location and Site Characteristics

Mohawk Tannery is located at 11 Warsaw Avenue in the City of Nashua, Hillsborough County, New Hampshire. The Site is located in a residential neighborhood directly across the river from the 325-acre Mine Falls Park. The tannery property slopes steeply toward the Nashua River, with a topographic relief of approximately 70 feet from the eastern boundary to the western boundary along the Nashua River. Groundwater was measured between 7 and 14 feet below ground surface in monitoring wells located in the vicinity of disposal Areas 1 and 2, and approximately 70 feet below ground surface in the eastern portion of the Site adjacent to Warsaw Avenue. The lower portion of the Site, which

contains Areas 1 and 2 and approximately 90 percent of the waste disposed of at the Site, is located predominantly within the 100-year floodplain of the river.

4. Release or Threatened Release into the Environment of a Hazardous Substance, or, Pollutant or Contaminant

Several private, State, and Federal investigations have confirmed the presence of numerous contaminants of potential concern (COPCs) at the Site. Most recently, as part of the EE/CA, EPA identified a number of COPCs at the Site as shown in the attached Table 1. The COPCs, which include VOCs, SVOCs, and metals, were selected based on a comparison of the maximum concentrations found in the waste disposal areas at the Site to the risk-based COPC screening levels identified for residential land use. Of the COPCs identified, the following compounds were detected at the greatest frequency and levels :

- Dioxins
- Semi-volatile Organic Compounds (including 4-methylphenol, pentachlorophenol)
- Metals (including antimony, chromium,)

Dioxin, 4-methylphenol (also known as p-cresol), pentachlorophenol, antimony, and chromium are hazardous substances as defined in Section 101(14) of CERCLA and as listed in 40 C.F.R. 302.4. Sampling results obtained during the EE/CA identified the following maximum concentrations in the waste disposal areas for the compounds discussed above: dioxin at 2.6 ppb; 4-methylphenol at 1,300 ppm; pentachlorophenol at 120 ppm; antimony at 547 ppm; and chromium at 67,800 ppm. Elevated levels of other VOCs, SVOCs, and metals were also identified at the Site as shown in the attached Table 2.

The past use of the property as a leather tannery is consistent with the presence of the hazardous substances which have been identified above as being released at the Site. The use of chromium as a tanning agent and phenolic compounds such as pentachlorophenol and 4-methylphenol as preservatives and biocides, is well documented in effluent limitation guideline documents developed by EPA for the leather tanning and finishing industry. It is also reported in literature that dioxin is a common impurity found in technical-grade formulations of pentachlorophenol.

The Streamlined Human Health Risk Evaluation conducted as part of the EE/CA for the NTCRA focused on the risks to humans from the soil and wastes contained in the six unlined disposal areas at the Site. The findings of the risk evaluation strongly indicate that there are unacceptable risks at the Site in the future for residents, if the property is developed in accordance with the current residential zoning. The potential future risks

identified at the Site exceed EPA's acceptable target cancer risk range (see attached Table 3) and non-cancer hazard index value (see attached Table 4). Additional details concerning the Streamlined Human Health Risk Evaluation can be found in Section 2.0 of the EE/CA.

EPA also completed a Streamlined Ecological Risk Evaluation during the EE/CA to investigate the current and future impacts of the waste disposal areas at the Site to on-site ecological receptors. This screening-level evaluation used conservative screening values to identify whether or not contaminants at the Site pose a potential ecological risk that might warrant further investigation. The results of the ecological evaluation indicate that contaminants at the Site pose a real concern for on-site receptors and potentially off-site receptors in the event of a release. The magnitude by which contaminants such as chromium and 4-methylphenol exceed their respective screening level benchmarks (both by approximately 30,000 times in the sediment found in Area 1), demonstrates a high potential for ecological risk and the need for further study. Although the relationship between the magnitude of exceeding such benchmarks and actual toxic effects is not necessarily linear, it can be used as a rough approximation of the extent of potential risks.

Over 50,000 of the approximately 60,000 cubic yards of waste buried at the Site (see attached Table 5) are located in Areas 1 and 2 next to the Nashua River. Areas 1 and 2, which are predominantly located within the 100-year floodplain of the river, have not been designed, constructed, operated, or maintained to prevent the washout of hazardous substances. In addition, over 50 percent of the waste found in these two areas is buried beneath the water table. Accordingly, this waste is not in compliance with State of New Hampshire regulations which do not allow waste below the water table to be left in place. Groundwater in contact with the waste in these two areas is likely migrating into the Nashua River, given the close proximity of Areas 1 and 2 to the Nashua River. The impacts of the waste disposal areas at the Site on the groundwater will be evaluated during the State-lead RI.

The potential for a release from the disposal areas is certainly a real concern as evidenced by NH DES personnel reportedly observing an area of dark liquid leaking from the base of the berm surrounding Area 1 into the Nashua River in 1987. A catastrophic event such as a flood, could release tens of thousands of cubic yards of waste into the Nashua River, an important component of the regional wildlife habitat. In addition, there is a drinking water intake located approximately 14 miles downstream of the Site on the Merrimack River which serves a population of over 100,000. The Nashua River joins the Merrimack River approximately 3 miles downstream of the Site.

In conclusion, there is a clear human health risk and strong potential for ecological risks associated with the waste present in the disposal areas at the Site. Additionally, a catastrophic event such as a flood could present additional risks for human and ecological

receptors located downstream of the Site. The Removal Action proposed as part of the NTCRA will eliminate these risks.

5. *NPL Status*

The Site was proposed on the National Priority List (NPL) on May 11, 2000, based upon letters of support from both the City of Nashua and the State of New Hampshire. In July of 2002, the City of Nashua submitted a letter to Senator Bob Smith of New Hampshire requesting that the finalization of the Mohawk Tannery Site on the NPL be delayed at this time. It is EPA's understanding that the City is exploring alternative means for funding the cleanup of the Site in lieu of placing the Site on the NPL. In response to the City's request, the Mohawk Tannery Superfund Site was not included in the most recent group of sites to be finalized on the NPL in September of 2002.

The NTCRA follows the completion of a Time-Critical Removal Action at the tannery (January of 2001) and the initiation of a Remedial Investigation (fall of 2002). Additional details for both of these actions are provided in Section B, below.

B. Other Actions to Date

1. Previous Actions

Since the mid 1980's, there have been several private response actions completed at the Site. The first of these activities occurred in 1985, when work was completed on behalf of the property owner to determine the impacts of the waste disposal areas on the groundwater and Nashua River. A report documenting the results of this investigation was finalized by Goldberg-Zoino & Associates in October of 1985. In late 2000, a private development team completed an investigation of the two largest disposal areas at the site (Areas 1 and 2). The purpose of the Brownfields Recovery Corporation (BRC) investigation was to further characterize the extent of contamination in the largest disposal areas and to determine the feasibility of a private party cleanup and redevelopment of the Site. Based on the results of their investigation and financial analysis, BRC advised the NH DES in November of 2000 that private cleanup of the property was not economically feasible due to the significant waste disposal costs. At the request of the NH DES, the property owner in July of 2001 arranged for the removal of some oily waste material from the Site. The cost of such removal was reportedly approximately \$5,000.

EPA conducted a Time-Critical Removal Action at the Site beginning in September of 2000 and concluding in January of 2001. Actions taken during this removal action included: removing and disposing of asbestos-containing material from the old tannery building; characterizing and disposing of the contents of 42 drums, a large above ground

storage tank, and a large clarifier tank; and removing approximately 110 empty drums and 360 laboratory-type containers and disposing of these materials at permitted off-site facilities. EPA also repaired a number of gates and posted warning signs about the dangers of trespassing to better secure the Site.

2. Current Actions

EPA entered into a Cooperative Agreement with the NH DES to perform the RI for the Mohawk Tannery Site as a State-lead project. The investigation is necessary for other portions of the Site which may have been potentially impacted by past waste disposal activities. The other areas that will require investigation include: the on-site buildings; the groundwater; the Nashua River; and, the undeveloped parcel located to the south of the tannery. The investigation will initially focus on the groundwater and on-site buildings and it is anticipated that these RI activities will begin during the spring of 2003. The NH DES has selected Sanborn, Head & Associates to perform the RI. If the RI does not identify any additional sources of contamination or risks exceeding acceptable EPA target risk ranges for the groundwater and on-site buildings, then the completion of the NTCRA may address all of the short-term goals as well as the long-term remedial measures needed to bring the Site back into productive use. An investigation of the parcel to the south and the Nashua River would still be necessary, but this could occur separately and independently of any future redevelopment or other use of the tannery property.

C. State and Local Authorities' Roles

1. State and Local Actions to Date

The NH DES has performed numerous tasks at the Site including extensive characterization and investigative activities. However, the State does not have the financial resources to address the significant problems which currently exist at the Site. In response to requests from the State, EPA performed emergency removal activities and proposed the Site on the NPL. Through a Cooperative Agreement with EPA, the NH DES is currently initiating a Remedial Investigation of the groundwater and on-site buildings. EPA and the NH DES continue to enjoy a close and cooperative working relationship.

The City of Nashua has also been consulted and regularly involved in cleanup related activities occurring at the Site. EPA and the NH DES have met with City Officials on numerous occasions to discuss topics which have included: the potential for private development of the property; future ownership of the property; the status of cleanup work; the status of listing the Site on the NPL; and waste disposal options. As mentioned previously, the City of Nashua, although initially supportive of the listing of the Mohawk

Tannery Site on the NPL, submitted a letter to Senator Bob Smith of New Hampshire on July 8, 2002, requesting that finalization of the Site on the NPL be delayed at this time. Representatives from the City have stated that they want to explore alternative means for funding the cleanup of the Site in lieu of placing the Site on the NPL. As a result, the Mohawk Tannery Superfund Site has not been finalized on the NPL.

2. Potential for Continued State/Local Response

Since the NH DES is the lead agency for the RI, the State will continue to play a key role in the completion of RI activities. The Cooperative Agreement with the State currently does not contain funding sufficient to complete the RI/FS for the Nashua River and the undeveloped parcel to the south. Therefore the status and timing of these additional investigations is currently not known. It is assumed that the City of Nashua will continue to play an active role in site-specific issues such as those mentioned above.

III. Threats to Public Health or Welfare or the Environment

A. Threats to the Public Health or Welfare

Section 300.415(b) of the National Contingency Plan (NCP) provides that EPA may conduct a removal action when it determines that there is a threat to human health or welfare or the environment based on one or more of the eight factors listed in 300.415(b)(2) of the NCP. The following factors listed below are present at this Site:

1. "Actual or potential exposure to nearby human populations, animals, or the food chain from hazardous substances or pollutants or contaminants;"
[300.415(b)(2)(i)].

With regard to actual or potential exposure to nearby human populations, EPA has documented elevated levels of hazardous substances including, but not limited to, dioxin, 4-methylphenol, pentachlorophenol, antimony, and chromium in six unlined waste disposal areas at the Site. At least one of the disposal areas (Area 1) at the abandoned tannery remains open and uncovered, with wastes easily accessible to trespassers entering the property. The Site abuts a densely settled neighborhood and there is evidence of children (mainly adolescents) entering the Site and playing in and around Area 1 potentially exposing themselves to the hazardous substances present there. The remainder of the waste disposal areas have been covered with fill, but the thickness of the fill as well as its ability to limit human exposure and migration of contaminants in the future is questionable at best. Additionally, the Site has been zoned residential and future development of the property is likely, given its close proximity to downtown Nashua. Development of the Site without

any further remediation would have the potential to expose future residents (both children and adults) to hazardous substances found at the surface and buried in many of the disposal areas.

The Streamlined Human Health Risk Evaluation conducted as part of the EE/CA for the NTCRA focused on the risks to humans from the soil and wastes contained in the disposal areas at the Site. The findings of the risk evaluation strongly indicate that there are unacceptable risks at the Site in the future for residents, if the property is developed in accordance with the current residential zoning. The potential future risks identified at the Site exceed EPA's acceptable target cancer risk range and non-cancer hazard index value (see attached Tables 3 and 4, respectively).

The potential for a release from the disposal areas is certainly a real concern as evidenced by NH DES personnel reportedly observing an area of dark liquid leaking from the base of the berm surrounding Area 1 into the Nashua River in 1987. A catastrophic event such as a flood, could release tens of thousands of cubic yards of waste into the Nashua River impacting the river, recreational users, and potentially downstream communities which use the Merrimack River as a drinking water source (the Nashua River joins the Merrimack River several miles downstream of the Site).

2. "High levels of hazardous substances or pollutants or contaminants in soils largely at or near the surface, that may migrate;" [300.415(b)(2)(iii)].

High levels of hazardous substances have been found in waste and soil largely at or near the surface of the Site. Although several of the waste disposal areas have been covered with fill, the thickness of the fill as well as its ability to limit the migration of contaminants is questionable at best. The migration of contaminants from the waste disposal areas through overland flow and erosion is likely, given the topography of the Site (i.e., the steep relief sloping down toward the Nashua River) and the lack of a designed and engineered cover for these areas.

As discussed in the EE/CA, a majority of the waste contained in Area 2 (estimated volume of approximately 30,000 cubic yards) is located within the 100-year floodplain of the Nashua River. The Area 1 lagoon is not located within the 100-year floodplain due to the elevation of the earthen berm that has been constructed around its perimeter. If the berm were ever breached during a 100-year flood event, then the contents of the lagoon, approximately 25,000 cubic yards of waste which are located below the 100-year flood elevation, could be released into the river. It is clear from the physical condition of both areas (i.e., lack of erosion

control and/or scouring prevention measures) and an earlier documented release from Area 1 into the Nashua River in 1987, that Areas 1 and 2 have not been designed and constructed to prevent the migration of hazardous substances.

3. “Weather conditions that may cause hazardous substances or pollutants or contaminants to migrate or be released;” [§300.415(b)(2)(v)].

The lower portions of the Site which contain the two largest waste disposal areas (e.g., containing 90 percent of the waste disposed of at the Site) are located predominantly in the 100-year floodplain of the Nashua River. These two areas, which abut the river, have not been designed, constructed, operated, or maintained to prevent the washout of hazardous substances in the event of a flood. The release of approximately 50,000 cubic yards of waste into the river would have a detrimental effect on the Nashua River from both a recreational use and wildlife habitat standpoint. It should also be noted that a release of contaminants into the Nashua River could also potentially impact the drinking water intake for the City of Lowell which is located approximately 14 miles downstream of the Site on the Merrimack River. This water intake serves a population of over 100,000.

4. “The availability of other appropriate federal or state response mechanisms to respond to the release;” [§300.415(b)(2)(vii)].

There are no other known federal or state funds or response mechanisms available to finance this action.

B. Threats to the Environment

1. “Actual or potential exposure to nearby human populations, animals, or the food chain from hazardous substances or pollutants or contaminants;” [300.415(b)(2)(i)].

The Area 1 lagoon remains open and uncovered with wastes easily accessible to likely environmental receptors. Potential receptors include plants, invertebrates, and terrestrial wildlife. In addition, a significant portion of the wastes at the Site have been placed unprotected within the 100-year floodplain of the Nashua River. EPA completed a Streamlined Ecological Risk Evaluation during the EE/CA to investigate the current and future impacts of the waste disposal areas at the Site to on-site ecological receptors. This screening-level evaluation used conservative screening values to identify whether or not contaminants at the Site pose a potential ecological risk that might warrant further investigation. The results of the ecological evaluation indicate that contaminants at the Site pose a real concern

for on-site receptors and potentially off-site receptors in the event of a release. The magnitude by which contaminants such as chromium and 4-methylphenol exceed their respective screening level benchmarks (both by approximately 30,000 times in the sediment found in Area 1), demonstrate a high potential for ecological risk and the need for further study. Although the relationship between the magnitude of exceeding such benchmarks and actual toxic effects is not necessarily linear, it can be used as a rough approximation of the extent of potential risks. A catastrophic event such as a flood, could release tens of thousands of cubic yards of waste into the Nashua River, an important component of the regional wildlife habitat. In conclusion, there is a clear potential for unacceptable ecological risks associated with the waste as presently disposed of at the Site and in the future if the waste were released into the Nashua River.

IV. Endangerment Determination

Actual or threatened releases of hazardous substances from this Site, if not addressed by implementing the response action selected in this Action Memorandum, may continue to present an imminent and substantial endangerment to public health, or welfare, or the environment.

V. Exemption from Statutory Limits

CERCLA §104(c) states that removal actions can exceed the 12-month and/or the \$2 million statutory limits if conditions meet either the “emergency exemption” criteria or the “consistency exemption” criteria. The consistency exemption requires that the proposed removal be appropriate and consistent with the remedial action to be taken. As described below, conditions and proposed actions at the Site meet the criteria for a consistency exemption.

A. Appropriateness

EPA OSWER directive 9360.0-12, “Guidance on Implementation of the Revised Statutory Limits on Removal actions”, April 6, 1987, states that an action is appropriate if the activity is necessary for any *one* of the following reasons:

1. To avoid a foreseeable threat;
2. To prevent further migration of contaminants;
3. To use alternatives to land disposal; **or**,
4. To comply with the off-site policy

The NTCRA described in Section VI below **meets criteria one and two identified above.**

The risk evaluation conducted as part of the EE/CA and summarized in this Action Memorandum demonstrates that contaminants in the waste disposal areas at the Site pose a foreseeable threat for future residents, if the property is developed in accordance with the current residential zoning. The potential future risks identified at the Site exceed EPA's acceptable target cancer risk range and non-cancer hazard index value. Removal of the contaminated wastes will reduce the risk of these health effects and avoid a foreseeable threat.

Approximately 50,000 cubic yards of the waste disposed of at the Site is located within the 100-year floodplain of the Nashua River. The waste has not been placed in areas which have been designed, constructed, operated, or maintained to prevent the washout of hazardous substances in the event of a flood. A release from one of the disposal areas into the Nashua River has already been documented by NH DES personnel in 1987. Therefore, the removal of these contaminated wastes would prevent further migration of contaminants into the Nashua River.

B. Consistency

This Site is proposed on the National Priority List. The earlier Time-Critical Removal Action and this NTCRA have been coordinated by the Removal and the Remedial Programs and their completion are likely to enhance the effectiveness of any further remedial action measures. The NH DES has been involved in all planning activities associated with this proposed action to ensure consistency with State regulations. At a minimum, the NTCRA will complete a significant portion, if not all, of the source control measures needed for the Site. In addition, the removal of the waste disposal areas may be sufficient to achieve the long-term remedial goals for the groundwater (i.e., active restoration of the groundwater may not be necessary once the source of the problem is removed). This may allow the Site to be put back into productive use while the Nashua River and the undeveloped parcel to the south are investigated in the future to determine if any further remedial action measures are necessary.

VI. Proposed Actions and Estimated Costs

A. Proposed Actions

Several technologies and process options were screened in the EE/CA as shown in the attached Table 6. Three technologies, excavation and off-site disposal, excavation and on-site disposal, and excavation and off-site treatment using

incineration, best satisfied the screening criteria and were fully developed as removal alternatives for complete evaluation against the three required criteria; effectiveness, implementability, and cost. As shown in the Comparative Analysis, attached as Table 7, the alternatives evaluated in detail present similar initial challenges for implementation since all three alternatives require excavation of the waste. However, Alternative 1 (excavation of the waste and off-site disposal at a permitted facility) is overall the easiest to implement since this alternative has the fewest issues associated with locating an off-site disposal facility capable of accepting wastes from the Site. The time frame to implement Alternatives 1 and 3 (excavation and off-site treatment using incineration) are similar and are both estimated to take approximately 12 months to complete from the date of contractor mobilization to the Site. The time frame to implement Alternative 2 (excavation and disposal in an on-site landfill) would take a little longer, approximately 16 months, because of the additional design and construction effort needed.

The cost for Alternative 1 of approximately \$15 million is less than the approximate \$50 million cost for Alternative 3, but it is more than the approximate \$6.3 million cost of Alternative 2. However, the perceived benefits of Alternative 1 appear to outweigh the cost advantage of Alternative 2 since excavation and off-site disposal permanently removes the contaminants from the Site and eliminates the possibility for people to be exposed to the contaminants at some future date.

All three alternatives are effective and protective of human health and the environment. When Alternatives 1 and 2 are compared for effectiveness, the primary advantage of Alternative 1 is that it does not require any long term operation and maintenance and it places fewer restrictions on the future use of the property. Based on these advantages, excavation and off-site disposal (Alternative 1) was selected for the NTCRA and is more fully described below.

1. Proposed Action Description

The Removal Action includes excavating waste material from the six known disposal areas at the Site and then transporting the waste off-site to a permitted facility for disposal. All waste found in these disposal areas at concentrations in excess of the Preliminary Remediation Goals (PRGs) identified in Table 8 would be excavated and taken off-site for disposal. EPA has estimated that there are approximately 60,000 cubic yards of waste at the Site which exceed the PRGs. Based on the sampling information obtained during the EE/CA, EPA believes that this waste can be safely disposed of in a Subtitle D landfill (a landfill designed for non-

hazardous wastes). A hazardous waste determination completed by the NH DES in April of 2002, also supports the current assumption that the waste from the Site would not be considered a RCRA hazardous waste.

Erosion and sedimentation control measures would be installed prior to the implementation of any intrusive Site activities. Given the proximity of the disposal areas to the Nashua River, such controls will have to be closely monitored and maintained over the life of the project. After installing erosion and sedimentation control measures, some of the next steps to occur would be: clearing and grubbing of vegetation; demolition and removal of structures which might interfere with the implementation of the NTCRA; and construction of site improvements (e.g., access roads, stockpile areas). Where possible, overlying fill which has been placed over the waste disposal areas will be segregated and stored for the subsequent backfilling of excavated areas. It is estimated that there may be approximately 9,500 cubic yards of overlying fill material at the Site.

Prior to commencing excavation in Area 1, all surface water would have to be pumped from this open lagoon and staged in a portable water storage tank at the Site while awaiting sampling and analysis. Contingent on the results of the laboratory analysis, the surface water would be discharged into the City of Nashua wastewater system via the on-site sewer line. Because excavation of wastes from Areas 1 and 2 (and possibly Area 3) will likely extend to depths below the water table, excavation and removal of these saturated wastes will require the design of a dewatering system. Similar to the procedures described above for the surface water in Area 1, standing water encountered during excavation would be pumped into a tank where solids would be allowed to settle. From there, the water would be pumped into another storage tank to await sampling and analysis. Based on some initial sampling results of the surface water in Area 1, it has been assumed that the surface water as well as dewatering liquids would not require additional treatment (other than settling) prior to their discharge into the sewer.

Given the odorous nature of the waste at the Site, it is likely that engineering controls will be needed during excavation activities to prevent odors and fugitive dust emissions. Odor control technologies and other controls such as dust suppressants and water sprays will be applied as appropriate during excavation, stockpiling, and hauling. A preliminary conceptual approach for implementing odor control was developed for the

EE/CA as described below. Additional details will be developed during the pre-design investigation or during implementation of the removal action.

Sulfide compounds appear to be the major cause of the objectionable odors associated with the waste at the Site. Such odors could be neutralized during excavation through the delivery of an atomizing mist to the active excavation area. The mist would consist of a solution of potable water mixed at varying ratios with a neutralizing reagent. Neutralizing reagents, which are commercially available, have been developed specifically to deal with sulfide as well as other objectionable odors. The odor control solution would be delivered through a distribution line installed around the perimeter of the active excavation area. The distribution line would contain up to several hundred nozzles which would be spaced to optimize coverage of the area of concern.

In order to improve the handling as well as the stability of the excavated wastes it is likely that bulking agents, such as lime, would have to be added to the wastes prior to their transport off-site. The need for bulking agents would be dependent primarily on the off-site disposal facility's requirements as well as the moisture content of the waste as it is placed in the on-site stockpile. The need for lime or other bulking agents would be assessed during pre-design investigations and/or through periodic assessments of conditions during the NTCRA.

Excavated wastes would be segregated into stockpiles while awaiting results of the waste characterization analysis required by the disposal facility. It is currently assumed that waste stockpile samples will be collected at a rate of one sample per 500 tons of excavated material. It is assumed that, similar to earlier results, waste characterization samples will confirm that the material is suitable for disposal at a RCRA Subtitle D landfill. However, for costing purposes in the EE/CA, cost scenarios have been evaluated to account for the potential that the waste from Area 1 is determined to be a RCRA characteristic hazardous waste. Hence the lower end of the \$15 to \$23 million cost range reflects all of the waste being disposed of off-site as non-hazardous; the upper end assumes that all of the material from Area 1 would be disposed of off-site as a RCRA characteristic hazardous waste subject to land disposal restrictions.

A number of options are being considered for transporting the wastes off-site. Given the significant volume of waste that will have to be disposed of and the densely settled residential neighborhood surrounding the Site,

transportation has been identified as one of the neighboring community's biggest concerns. EPA is currently evaluating both truck and rail transport as well as alternatives for getting the waste from the Site to the nearest highway or rail spur. It is likely that a decision on the method of disposal will depend on the results of the bidding process and contract negotiations for the project. Accordingly, there will be additional opportunities in the future for the public to provide input on this issue before a final decision is reached.

Following completion of excavation, the former waste disposal areas will be backfilled using clean fill. All excavations would be backfilled to an elevation no higher than the original grade. At certain locations it may be appropriate to backfill to below the original grade. Thus, the flood storage capacity of the Site should not be impacted in a negative manner by the NTCRA. Following backfilling, cleared or denuded areas would be graded and revegetated to reduce erosion and sediment transport.

Implementation of the Removal Action is expected to have limited short-term impacts on the local community, workers, and the environment. To minimize the potential impacts, steps will be taken to control dust, odors and noise during excavation and off-site transportation. EPA will work closely with the community to identify appropriate transportation routes and hours of operation for the cleanup. Workers who implement the cleanup will be protected through the use of appropriate protective gear and proper safety practices. The public as well as workers will be further protected through air monitoring for the principle contaminants of concern.

The only anticipated Post-Removal Site Control (PRSC) activity associated with this Removal Action would be to inspect and maintain, during the first few years after implementation, the new vegetative cover and erosional control measures put in place at the Site. The proposed alternative was not modified significantly as a result of public comment.

2. Contribution to Remedial Performance

The NH DES has just initiated an RI which will evaluate the need for, and the extent of, remedial action for areas of the Site not being addressed by the NTCRA. The RI will focus on the groundwater, on-site buildings, and any other known areas of the Site where past waste disposal practices may have impacted the soil. Based on current information, the final overall

cleanup action for the Mohawk Tannery Site would be anticipated to include a source control component and potentially a management of migration component. It is possible that the implementation of the NTCRA (i.e., removal of known waste disposal areas) will effectively complete all of the source control measures necessary for the Site. In addition, if the RI identifies that there are no unacceptable risks associated with the groundwater, on-site buildings, and other areas of the Site, then no further long-term remedial measures may be necessary for the Site. It should be noted that the current level of RI funding is not sufficient to complete the investigation of the Nashua River as well as the undeveloped parcel located to the south of the tannery. As such, these areas will have to be investigated separately from those areas addressed in the current RI.

3. Description of Alternative Technologies and Actions

In accordance with Section 4.0 (Development of Removal Action Alternatives) and Section 5.0 (Analysis of Removal Action Alternatives) of the EE/CA, a number of alternatives appropriate for addressing the removal action objectives were screened, identified and assessed. One of the three alternatives to make it beyond the screening process, Alternative 3 (excavation and off-site treatment using incineration), involved treatment, while the other two alternatives (Alternative 1 - excavation and off-site disposal in a landfill; and Alternative 2 - excavation and disposal in an on-site landfill) involved land disposal. The technologies were screened against the three selection criteria (e.g., effectiveness, implementability, and cost) as shown in attached Table 7. Based on the advantages identified in Table 7, excavation and off-site disposal (Alternative 1) was selected for this NTCRA.

4. Engineering Evaluation/Cost Analysis ("EE/CA") or Equivalent

Section 300.415(b)(4) of the NCP states that whenever a planning period of six months exists before on-site activities must be initiated, and the lead agency determines a removal action is appropriate, the lead agency shall conduct an EE/CA or its equivalent. An Approval Memorandum to perform an EE/CA for this NTCRA was approved by the OSRR Division Director on July 12, 2000. EPA issued the EE/CA report in July 2002 and held a 30-day public comment period from July 30, 2002 to August 29, 2002. During the public comment period, EPA held a public meeting on August 7, 2002, to present the results of the EE/CA, and a public hearing on August 20, 2002, to accept public comments.

The State and the community have provided comments on the EE/CA, and have expressed a general acceptance of the recommended Alternative 1. EPA has provided written responses to comments received on the EE/CA. The responses are included in the Responsiveness Summary provided in Appendix C to this Action Memorandum.

5. Applicable or Relevant and Appropriate Requirements (ARARs)

40 CFR 300.415(i) requires that Fund-financed removal actions at CERCLA sites meet Applicable or Relevant and Appropriate Requirements (ARARs) to the extent practicable considering the urgency of the situation and the scope of the removal. ARARs are promulgated, enforceable federal and state, environmental or public health requirements that are determined to be legally applicable or relevant and appropriate to the hazardous substances, cleanup actions, or other circumstances occurring at a CERCLA site.

TBCs (standards and guidance To Be Considered) are non-promulgated advisories or guidance issued by federal or state government that are not legally binding, but may be considered during the development of alternatives. There are three types of ARARs and TBCs that must be considered in planning CERCLA actions: chemical-specific, location-specific, and action-specific.

Chemical-specific ARARs and TBCs are typically health or risk based numerical values that are used to establish the acceptable amount or concentration of a chemical that may remain in, or be discharged to, the environment. Location-specific ARARs and TBCs are restrictions placed on the conduct of activities solely because they are in specific areas. Action-specific ARARs and TBCs are usually technology or activity based requirements or limitations on actions taken with respect to hazardous waste.

A complete listing and explanation of all ARARs and TBCs for this NTCRA are included in attached Tables 9 through 11. The following discussion provides a brief overview of the ARARs discussion provided in Section 3.0 of the EE/CA.

Chemical-Specific ARARs

The EPA Region IX Preliminary Remediation Goals, EPA's OSWER Directive *Approach to Addressing Dioxin in Soil at CERCLA and RCRA Sites*, and the NH DES Risk Characterization and Management Policy Method 1 soil standards and background concentrations of metals in soils are among the TBCs that were used in the data evaluation and the Streamlined Human Health Risk Evaluation to identify contaminants of potential concern and to identify PRGs.

Location-Specific ARARs

The majority of the federal and state location-specific ARARs and TBCs relate to actions which may impact wetlands (Executive Order 11990), occur in a floodplain (Executive Order 11998), or require dredging or filling (40 CFR 230). During the EE/CA, a wetlands determination was completed for the 15-acre developed parcel to the north on which the tannery is situated as well as on the 15-acre undeveloped parcel to the south. No wetland areas were identified on the tannery property itself, and the two wetland areas found on the undeveloped parcel to the south of the tannery will not be impacted by the Removal Action. Disposal areas 1 and 2 are located within the 100-year floodplain of the Nashua River and, thus, work within the floodplain cannot be avoided. However, steps will be taken to prevent any impacts to the floodplain capacity of the Site. All identified ARARs will be attained.

Action-Specific ARARs

A variety of federal and state action-specific ARARs were identified dealing primarily with issues of facility standards (RCRA), water quality monitoring (CWA), air monitoring (CAA), and fugitive dust and emissions (CAA). In many instances, the State of New Hampshire has been delegated the responsibility for implementing these federal programs and as such it is the State action-specific standards which have been identified in Table 11. The determination of whether RCRA regulations are applicable or relevant and appropriate at the Site is dependent upon whether the waste is classified as a RCRA characteristic hazardous waste. The NH DES completed an updated hazardous waste determination for the Site in April of 2002, using the data gathered during the EE/CA. The data and the NH DES determination support the current assumption that the waste from the six unlined disposal areas at the Site would not be considered a hazardous waste. A final decision on the regulatory status of the waste will be made during implementation of the removal action based

on the results of the waste characterization samples. All identified ARARs will be attained.

6. Project Schedule

It is estimated that the overall Removal Action will take approximately 12 months to complete from the date that a contractor mobilizes to the Site. This schedule is dependent upon the weather and could be extended by several months if severe weather conditions are encountered. EPA anticipates submitting its request for funding for the NTCRA during the fall of 2002.

B. Estimated Costs

EPA recently completed a Time-Critical Removal Action at the Mohawk Tannery Site. The overall cost incurred by EPA at the Site through June 6, 2002, was approximately \$1.3 million. As discussed in Section V and consistent with Section 104(c)(2) of CERCLA, a \$2 million dollar "consistency" exemption is being requested as part of this Action Memorandum.

As the Mohawk Tannery Site was not operated by a state or political subdivision, pursuant to Section 300.525(b) of the NCP, there is no requirement for a state cost-share for the NTCRA. The following costs are estimated for this NTCRA.

Extramural Costs

NTCRA Response Contractor	\$13,581,134
10% Project Contingency	\$ 1,358,113
Annual PRSC*	\$ 4,000
Total Extramural Costs	\$14,943,247

*Post-Removal Site Control (i.e., inspections of Site)

Intramural Costs

EPA Regional Personnel	\$ 100,000
TOTAL NTCRA PROJECT CEILING	\$15,043,000

For additional information on the costs breakdown and assumptions used in the extramural cost estimate, please refer to Appendix L of the EE/CA.

It should be noted that for costing purposes in the EE/CA, disposal costs for the waste were based upon transportation by truck to a nearby Subtitle D facility in New Hampshire. Since the completion of the EE/CA, EPA, the NH DES, and City of Nashua Officials have had some preliminary discussions with other transportation vendors and it appears that there may be a significant cost savings of between one to two million dollars if rail transport and disposal facilities beyond the immediate area are considered. The project would likely be bid in a manner to consider all modes of transportation to take advantage of such potential cost savings.

VII. Expected Change in the Situation Should Action be Delayed or Not Taken

A delay or lack of action will increase the risks to human health and the environment by allowing for: (1) the potential direct contact, ingestion, and adsorption of dioxin and other hazardous substances by future residents who might come into contact with wastes; and (2) the potential continued migration of waste contaminated with dioxin and other hazardous substances into the groundwater and the Nashua River.

VIII. Outstanding Policy Issues

A. Dioxin Reassessment

The EPA Dioxin Reassessment effort began in 1991, when EPA announced that it would conduct a scientific reassessment of the health risks resulting from exposure to 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD) and chemically similar compounds collectively known as dioxin. The process for developing the Dioxin Reassessment has been open and participatory. Each portion of the reassessment has been developed in collaboration with scientists from inside and outside the federal government. In September, 1994, EPA released the public review draft of the Dioxin Reassessment Documents, which included three major reports: Estimating Exposure to Dioxin-Like Compounds, Health Assessment Document for 2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD) and Related Compounds, and Risk Characterization of 2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD) and Related Compounds. The September 1994 release of the draft Dioxin Reassessment Documents was followed by a 150-day comment period and 11 public meetings around the country to receive oral and written comments. In addition to this public review, each document was reviewed by EPA's Science Advisory Board (SAB). In response to the SAB, public comments, and newly available scientific information, EPA has been working to revise and update the 1994 draft.

On June 12, 2000, EPA released a second draft reassessment, which is entitled *Exposure and Human Health Reassessment of 2,3,7,8-Tetrachlorodibenzo-p-Dioxin (TCDD) and Related Compounds*. Based on a more complete understanding of dioxin toxicity, the draft finds that risks to people may be somewhat higher than previously believed. Following completion of the public and scientific review, EPA will issue a final dioxin reassessment document. At the same time, EPA also plans to publish a draft dioxin Risk Management Strategy for public comment. The strategy will propose EPA policy and programs for dioxin using reassessment as its scientific basis.

EPA OSWER Directive 92000.4-26, *Approach for Addressing Dioxin in Soil at CERCLA and RCRA Sites*, issued on April 13, 2000, generally recommends 1 ppb (TEQs, or toxicity equivalent) to be used as a starting point for a residential soil cleanup level for CERCLA non-time critical removal sites and as a preliminary remediation goal (PRG) for remedial sites, pending release of the final dioxin reassessment document. These recommended levels also apply to sediments in the event that this environmental medium is considered to be a direct exposure pathway for human receptors. Based on this guidance, 1 ppb of dioxins (as 2,3,7,8-TCDD) has been established as the PRG for the Site since it is zoned residential.

It is anticipated that following issuance of the final dioxin reassessment report, OSWER will issue guidance, informed by the reassessment effort, that will provide a basis for the selection of dioxin cleanup levels. In accordance with the 1998 Guidance, EPA intends to review the Action Memorandum promptly following the release and analysis of the reassessment report and OSWER guidance, and, if necessary, to make changes to the Action Memorandum and cleanup actions, based on the information contained in the reassessment report and the OSWER guidance.

For additional information, please refer to EPA Dioxin Information Sheets 1 through 5, dated June 12, 2000, and EPA OSWER Directive 92000.4-26, *Approach for Addressing Dioxin in Soil at CERCLA and RCRA Sites*, issued on April 13, 2000, included in the Administrative Record.

IX. Enforcement

See attached. **(FOR INTERNAL DISTRIBUTION ONLY.)**

X. Recommendation

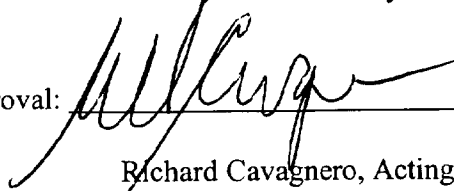
This decision document represents the selected NTCRA for the Mohawk Tannery Superfund Site in Nashua, New Hampshire. The removal action was developed in accordance with CERCLA, as amended, and is not inconsistent with the NCP. This decision document is based on documents contained in the Administrative Record established for the Site. (See Appendix D for the Administrative Record File Index)

Conditions at the Site meet the NCP §300.415(b)(2) criteria for removal and the CERCLA §104(c) consistency exemption from the \$2 million limitation due to the presence of:

- “Actual or potential exposure to nearby human populations, animals, or the food chain from hazardous substances, or pollutants or contaminants” [300.415(b)(2)(i)];
- “High levels of hazardous substances or pollutants or contaminants in soils largely at or near the surface, that may migrate” [300.415(b)(2)(iv)],
- “Weather conditions that may cause hazardous substances or pollutants or contaminants to migrate or be released” [300.415(b)(2)(v)],
- “The availability of other appropriate federal or state response mechanisms to respond to the release” [300.415(b)(2)(vii)], and
- “Continued response action is otherwise appropriate and consistent with the remedial action to be taken” [CERCLA §104(c)].

The removal actions proposed in this Action Memorandum will abate, prevent, minimize, stabilize, mitigate and/or eliminate the release or threat of release of hazardous substances at the Site. Therefore, I recommend your approval of this Action Memorandum.

Approval: _____



Richard Cavagnero, Acting Director
Office of Site Remediation and Restoration
EPA New England, Region I

Date: _____

Oct 29, 2002

Disapproval: _____

Date: _____

Richard Cavagnero, Acting Director
Office of Site Remediation and Restoration
EPA New England, Region I

Attachments:

Appendix A: Tables
Appendix B: Figures
Appendix C: Responsiveness Summary
Appendix D: Administrative Record File Index

Enforcement Strategy (Confidential)

APPENDIX A

TABLES

Action Memorandum
Mohawk Tannery Site
Nashua, New Hampshire

TABLE 1
SUMMARY OF COMPOUNDS EXCEEDING SCREENING CRITERIA IN SLUDGE/WASTE
FINAL ENGINEERING EVALUATION/COST ANALYSIS
MOHAWK TANNERY SITE
NASHUA, NEW HAMPSHIRE

	Area 1	Area 2	Area 3	Area 4	Area 5	Area 6	Area 7
Volatile Organic Compounds (UG/KG)							
1,2-Dichlorobenzene						X	
1,4-Dichlorobenzene						X	
2-Butanone	X						
Carbon Disulfide	X	X		X			
Chlorobenzene						X	
Semivolatile Organic Compounds (UG/KG)							
2-Methylnaphthalene	X						
4-Methylphenol	X	X		X			X
Benzo(a)pyrene							X
Naphthalene		X	X			X	
Pentachlorophenol	X	X	X			X	X
Phenol		X					
Pesticides/PCBs (UG/KG)							
Aldrin		X					
Aroclor-1242							X
Heptachlor Epoxide		X					
Dioxins (NG/KG)							
2,3,7,8-TCDD	X	X	X			X	X
Toxicity Equivalency	X	X				X	X
Metals (MG/KG)							
Antimony	X	X	X	X	X	X	X
Arsenic	X	X	X	X	X	X	X
Barium						X	X
Cadmium							X
Chromium	X	X	X	X		X	X
Lead							X
Manganese	X			X			X
Mercury							X
Thallium				X		X	X
Vanadium						X	
Chromium VI (MG/KG)							
RCRA Analyses							
Paint Filter (ML/KG)				X			
Reactive Sulfide (MG/KG)	X						

TABLE 2
OCCURRENCE, DISTRIBUTION AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN
"ALL" SOIL/SLUDGE AREAS 1 THROUGH 7
FINAL ENGINEERING EVALUATION/COST ANALYSIS
MOHAWK TANNERY SITE
NASHUA, NEW HAMPSHIRE

Scenario Timeframe: Future
Medium: Soil/Sludge
Exposure Medium: Soil/Sludge
Exposure Point: All Soil and Sludge Areas 1 to 7

CAS Number	Chemical	Minimum (1) Concentration	Minimum Qualifier	Maximum (1) Concentration	Maximum Qualifier	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration Used for Screening	Background (2) Value	Screening (3) Toxicity Value	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag	Rationale for (4) Contaminant Deletion or Selection
120-82-1	1,2,4-Trichlorobenzene	35	J	570	J	ug/kg	MT-SL-601-0711	5/33	170 - 1300	570		65000 nc			NO	BSL
95-50-1	1,2-Dichlorobenzene	32	J	45000		ug/kg	MT-SL-601-0711	15/33	180 - 1300	46000		90000 nc_1			NO	BSL
106-46-7	1,4-Dichlorobenzene	15	J	25000		ug/kg	MT-SL-601-0711	12/33	180 - 1300	25000		3400 ca			YES	ASL
78-83-3	2-Butanone	510		2200		ug/kg	MT-SL-101-0010	5/33	170 - 1300	2200		730000 nc			NO	BSL
67-64-1	Acetone	210		4300		ug/kg	MT-SL-704-0207-AVG	12/33	170 - 710	4300		160000 nc			NO	BSL
75-15-0	Carbon Disulfide	54	J	6100		ug/kg	MT-SL-102-0012	14/33	180 - 1300	6100		36000 nc			NO	BSL
106-90-7	Chlorobenzene	25	J	77000		ug/kg	MT-SL-601-0711	7/33	170 - 1300	77000		15000 nc			YES	ASL
67-66-3	Chloroform	19	J	79	J	ug/kg	MT-SL-403-0510	9/33	180 - 1300	79		240 ca**			NO	BSL
100-41-4	Ethylbenzene	120	J	380	J	ug/kg	MT-SL-601-0711	2/33	170 - 1300	380		150000 nc_1			NO	BSL
79-20-9	Methyl Acetate	44	J	8900		ug/kg	MT-SL-102-0012	20/33	180 - 330	8900		2200000 nc			NO	BSL
127-18-4	Tetrachloroethene	170	J	170	J	ug/kg	MT-SL-401-0511	1/33	170 - 1300	170		5700 ca*			NO	BSL
106-88-3	Toluene	19	J	9200		ug/kg	MT-SL-402-0311	11/33	170 - 1300	9200		59000 nc_1			NO	BSL
1330-20-7	Total Xylenes	280	J	2300		ug/kg	MT-SL-601-0711	3/29	170 - 1300	2300		140000 nc_1			NO	BSL
95-95-4	2,4,6-Trichlorophenol	380	J	70000	J	ug/kg	MT-SL-602-0509	9/33	440 - 330000	70000		610000 nc			NO	BSL
91-58-7	2-Chloronaphthalene	1700	J	5200	J	ug/kg	MT-SL-201-0616	2/33	170 - 130000	5200		390000 nc			NO	BSL
91-57-6	2-Methylnaphthalene	1800	J	21000	J	ug/kg	MT-SL-102-0012	5/33	170 - 130000	21000		5600 nc			YES	ASL
59-50-7	4-Chloro-3-methylphenol	550	J	550	J	ug/kg	MT-SL-703-0215	1/33	170 - 130000	550		31000 ca			NO	BSL
106-44-5	4-Methylphenol	1200	J	1300000		ug/kg	MT-SL-102-0012	11/16	180 - 130000	1300000		31000 nc			YES	ASL
50-32-8	Benzo(a)pyrene	660	J	660	J	ug/kg	MT-SL-701-0217	1/33	170 - 130000	660		62 ca			YES	ASL
205-99-2	Benzo(b)fluoranthene	470	J	470	J	ug/kg	MT-SL-701-0217	1/33	170 - 130000	470		620 ca			NO	BSL
207-08-9	Benzo(k)fluoranthene	790	J	790	J	ug/kg	MT-SL-701-0217	1/33	170 - 130000	790		6200 ca			NO	BSL
117-81-7	bis(2-Ethylhexyl)phthalate	8900		15000	J	ug/kg	MT-SL-401-0511	2/33	170 - 130000	15000		35000 ca*			NO	BSL
218-01-9	Chrysene	590	J	590	J	ug/kg	MT-SL-701-0217	1/33	170 - 130000	590		62000 ca			NO	BSL
84-74-2	Di-n-Butylphthalate	23	JEB	61		ug/kg	MT-SL-601-0020-AVG	2/33	180 - 130000	61		610000 nc			NO	BSL
205-44-0	Fluoranthene	1100	J	1100	J	ug/kg	MT-SL-701-0217	1/33	170 - 130000	1100		230000 nc			NO	BSL
85-30-6	N-Nitroso-diphenylamine	7600	J	7600	J	ug/kg	MT-SL-602-0509	1/33	170 - 130000	7600		99000 ca			NO	BSL
91-20-3	Naphthalene	760	J	61000		ug/kg	MT-SL-202-0717-AVG	7/33	170 - 68000	61000		5600 nc			YES	ASL
87-86-6	Pentachlorophenol	120	J	120000	J	ug/kg	MT-SL-602-0509	12/33	440 - 330000	120000		3000 ca			YES	ASL
85-01-8	Phenanthrene	620	J	620	J	ug/kg	MT-SL-701-0217	1/33	170 - 130000	620		2200000 nc			NO	BSL
106-85-2	Phenol	390	JEB	52000		ug/kg	MT-SL-202-0717-AVG	9/33	170 - 130000	52000		3700000 nc			NO	BSL
129-00-0	Pyrene	900	J	900	J	ug/kg	MT-SL-701-0217	1/33	170 - 130000	900		230000 nc			NO	BSL
72-64-8	4,4'-DDD	3.4	J	34	J	ug/kg	MT-SL-601-0711	6/33	1.7 - 17	34		2400 ca			NO	BSL
72-65-9	4,4'-DDE	1.5	J	53	J	ug/kg	MT-SL-602-0509	15/33	1.7 - 6.5	53		1700 ca			NO	BSL
50-29-3	4,4'-DDT	1.8	J	5.6	J	ug/kg	MT-SL-602-0509	4/33	1.7 - 17	5.6		1700 ca*			NO	BSL
309-00-2	Aldrin	6.1	J	29		ug/kg	MT-SL-202-0717-AVG	3/33	0.87 - 3.4	29		29 ca*			NO	BSL
319-84-6	alpha-BHC	4.6		24	J	ug/kg	MT-SL-104-0010	4/33	0.87 - 8.9	24		90 ca			NO	BSL
5103-71-9	alpha-Chlordane	1.6		340		ug/kg	MT-SL-202-0717-AVG	19/33	0.87 - 3.4	340		1600 ca			NO	BSL
53489-21-9	Aroclor-1242	280		280		ug/kg	MT-SL-702-0011	1/33	17 - 170	280		220 ca			YES	ASL
11097-69-1	Aroclor-1254	4	J	180		ug/kg	MT-SL-401-0511	11/33	17 - 61	180		220 ca**			NO	BSL

TABLE 2 (CONT.)
OCCURRENCE, DISTRIBUTION AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN
"ALL" SOIL/SLUDGE AREAS 1 THROUGH 7
FINAL ENGINEERING EVALUATION/COST ANALYSIS
MOHAWK TANNERY SITE
NASHUA, NEW HAMPSHIRE
PAGE 2 OF 3

Scenario Timeframe: Future
Medium: Soil/Sludge
Exposure Medium: Soil/Sludge
Exposure Point: All Soil and Sludge Areas 1 to 7

CAS Number	Chemical	Minimum (1) Concentration	Minimum Qualifier	Maximum (1) Concentration	Maximum Qualifier	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration Used for Screening	Background (2) Value	Screening (3) Toxicity Value	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag	Rationale for (4) Contaminant Deletion or Selection
319-85-7	beta-BHC	2.2		18		ug/kg	MT-SL-203-0619	5/33	0.87 - 3.4	18		320 ca			NO	BSL
319-86-8	delta-BHC	3.2		18		ug/kg	MT-SL-202-0717-AVG	3/33	0.87 - 3.4	18		440 ca*			NO	BSL
80-57-1	Dieldrin	4.4		12		ug/kg	MT-SL-202-0717-AVG	4/33	1.7 - 6.5	12		30 ca			NO	BSL
72-20-8	Endrin	5.8		5.9	J	ug/kg	MT-SL-601-0711	2/33	1.7 - 17	5.9		1800 nc			NO	BSL
53494-70-6	Endrin Ketone	5.8		26	J	ug/kg	MT-SL-601-0711	4/33	1.7 - 17	26		1800 nc			NO	BSL
5103-74-2	gamma-Chlordane	1.7		500		ug/kg	MT-SL-202-0717-AVG	18/33	0.87 - 3.4	500		1600 ca			NO	BSL
78-44-8	Heptachlor	28	J	56	J	ug/kg	MT-SL-104-0010	2/33	0.87 - 8.9	56		110 ca			NO	BSL
1024-67-3	Heptachlor Epoxide	1.5		48		ug/kg	MT-SL-202-0717-AVG	6/33	0.87 - 3.4	48		53 ca*			NO	BSL
36822-48-8	1,2,3,4,6,7,8-HpCDD	10.8		93940		ng/kg	MT-SL-702-0011	33/33	0 - 0	93940					NO	NTX
57582-38-4	1,2,3,4,6,7,8-HpCDF	1.2		17200	JEB	ng/kg	MT-SL-802-0509	33/33	0 - 0	17200					NO	NTX
36873-88-7	1,2,3,4,7,8,9-HpCDD	2.8	J	990	JEB	ng/kg	MT-SL-802-0509	30/33	0.45 - 5.2	990					NO	NTX
36827-28-6	1,2,3,4,7,8-HxCDD	0.71	J	390		ng/kg	MT-SL-103-0010-AVG	29/33	0.35 - 3.1	390					NO	NTX
70848-28-9	1,2,3,4,7,8-HxCDF	1.3	J	758	JEB	ng/kg	MT-SL-601-0711	30/33	0.2 - 2.7	758					NO	NTX
57883-85-7	1,2,3,6,7,8-HxCDD	3.1	J	4690	JEB	ng/kg	MT-SL-802-0509	32/33	0.35 - 0.35	4690					NO	NTX
57117-44-9	1,2,3,6,7,8-HxCDF	0.6	J	229	J	ng/kg	MT-SL-802-0509	29/33	0.2 - 2.7	229					NO	NTX
19408-74-3	1,2,3,7,8,9-HxCDD	1.6	JEB	1530	JEB	ng/kg	MT-SL-101-0010	32/33	0.35 - 0.35	1530					NO	NTX
72918-21-8	1,2,3,7,8,9-HxCDF	0.74	EMPC	10.8	EMPC	ng/kg	MT-SO-A6-OVCOMP	5/33	0.1 - 5.7	10.8					NO	NTX
40321-78-4	1,2,3,7,8-PeCDD	0.54	EMPC	395	JEB	ng/kg	MT-SL-101-0010	28/33	0.2 - 3.6	395					NO	NTX
57117-41-6	1,2,3,7,8-PeCDF	0.27	J	148		ng/kg	MT-SL-103-0010-AVG	13/33	0.09 - 2.4	148					NO	NTX
60851-34-5	2,3,4,6,7,8-HxCDF	1.3	J	488	JEB	ng/kg	MT-SL-802-0509	29/33	0.25 - 4.7	488					NO	NTX
57117-31-4	2,3,4,7,8-PeCDF	0.25	EMPC	91.9	JEB	ng/kg	MT-SL-601-0711	25/33	0.1 - 2.2	91.9					NO	NTX
1748-01-6	2,3,7,8-TCDD	0.39	J	1240	J	ng/kg	MT-SL-802-0509	30/33	0.25 - 1.8	1240		3.9 ca			YES	ASL
51207-31-8	2,3,7,8-TCDF	0.24	EMPC	26.9	J	ng/kg	MT-SL-601-0711	25/32	0.2 - 2.1	26.9					NO	NTX
3288-87-8	OCDD	99.9		922000	J	ng/kg	MT-SL-601-0711	33/33	0 - 0	922000					NO	NTX
39001-02-0	OCDF	2.6		33200	JEB	ng/kg	MT-SL-601-0711	33/33	0 - 0	33200					NO	NTX
37871-00-4	Total HpCDD	18.6		161180	J	ng/kg	MT-SL-702-0011	33/33	0 - 0	161180					NO	NTX
38998-75-3	Total HpCDF	4.2		75200	JEB	ng/kg	MT-SL-802-0509	33/33	0 - 0	75200					NO	NTX
34485-46-8	Total HxCDD	1.2		20400	JEB	ng/kg	MT-SL-601-0711	33/33	0 - 0	20400					NO	NTX
59684-84-1	Total HxCDF	5.6	JEB	27600	JEB	ng/kg	MT-SL-802-0509	32/33	0.75 - 0.75	27600					NO	NTX
36088-22-8	Total PeCDD	0.8		5100	JEB	ng/kg	MT-SL-101-0010	33/33	0 - 0	5100					NO	NTX
30402-15-4	Total PeCDF	2.5	J	1690	JEB	ng/kg	MT-SL-601-0711	31/33	0.25 - 0.3	1690					NO	NTX
41903-67-6	Total TCDD	0.48	EMPC	1550		ng/kg	MT-SL-103-0010-AVG	31/33	0.25 - 1.8	1550					NO	NTX
55722-27-6	Total TCDF	0.51	JEB	470	J	ng/kg	MT-SL-101-0010	30/33	0.2 - 1.4	470					NO	NTX
Dioxin TEQ	Toxicity Equivalency	0.13		2600	J	ng/kg	MT-SL-802-0509	33/33	0 - 0	2600		3.9 ca			YES	ASL
7429-90-6	Aluminum	2000		10600		mg/kg	MT-SL-802-0509	33/33	0 - 0	10600					NO	EPA
7440-38-0	Antimony	1.2	J	547	J	mg/kg	MT-SL-602-0509	25/32	0.74 - 0.74	547		3.1 nc			YES	ASL
7440-38-2	Arsenic	1.2	J	15.7		mg/kg	MT-SL-803-0007	32/33	1 - 1	15.7		0.39 ca*			YES	ASL
7440-39-3	Barium	12.9		1480	J	mg/kg	MT-SL-703-0215	33/33	0 - 0	1480		540 nc			YES	ASL
7440-41-7	Beryllium	0.08		0.41	J	mg/kg	MT-SL-204-0618, MT-SL-603-0007, MT-SO-A7-UNCOMP	25/33	0.16 - 0.27	0.41		15 nc			NO	BSL

TABLE 2 (CONT.)
OCCURRENCE, DISTRIBUTION AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN
"ALL" SOIL/SLUDGE AREAS 1 THROUGH 7
FINAL ENGINEERING EVALUATION/COST ANALYSIS
MOHAWK TANNERY SITE
NASHUA, NEW HAMPSHIRE
PAGE 3 OF 3

Scenario Timeframe: Future
Medium: Soil/Sludge
Exposure Medium: Soil/Sludge
Exposure Point: All Soil and Sludge Areas 1 to 7

CAS Number	Chemical	Minimum (1) Concentration	Minimum Qualifier	Maximum (1) Concentration	Maximum Qualifier	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration Used for Screening	Background (2) Value	Screening (3) Toxicity Value	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag	Rationale for (4) Contaminant Deletion or Selection
7440-43-9	Cadmium	0.74	J	18.8		mg/kg	MT-SL-702-0011	4/33	0.52 - 0.68	16.8		3.7 nc			YES	ASL
7440-70-2	Calcium	560		156000		mg/kg	MT-SL-103-0010-AVG	33/33	0 - 0	156000					NO	NUT
7440-47-3	Chromium	12.8		67800	J	mg/kg	MT-SL-602-0509	33/33	0 - 0	67800		12000 ca			YES	ASL
7440-48-4	Cobalt	1.8		7.4	J	mg/kg	MT-SL-104-0010	33/33	0 - 0	7.4					NO	EPA I
7440-50-8	Copper	4.4		274		mg/kg	MT-SL-703-0215	33/33	0 - 0	274					NO	EPA I
7439-89-6	Iron	3370		25500		mg/kg	MT-SL-702-0011	33/33	0 - 0	25500					NO	EPA I
7439-92-1	Lead	2.5		427		mg/kg	MT-SL-702-0011	33/33	0 - 0	427		400 nc			YES	ASL
7439-95-4	Magnesium	253		4010		mg/kg	MT-SL-201-0616	33/33	0 - 0	4010					NO	NUT
7439-96-6	Manganese	25.2		13300		mg/kg	MT-SL-102-0012	33/33	0 - 0	13300		180 nc			YES	ASL
7439-97-6	Mercury	0.02	J	4.5		mg/kg	MT-SL-702-0011	26/31	0.02 - 0.02	4.5		2.3 nc			YES	ASL
7440-02-0	Nickel	3.4		24.5		mg/kg	MT-SL-702-0011	33/33	0 - 0	24.5		160 nc			NO	BSL
7440-09-7	Potassium	74.7		2410	J	mg/kg	MT-SL-201-0616	33/33	0 - 0	2410					NO	NUT
7782-49-2	Selenium	1.3		1.3		mg/kg	MT-SL-103-0010-AVG	1/33	0.87 - 1.1	1.3		39 nc			NO	BSL
7440-22-4	Silver	1.7		6.2	J	mg/kg	MT-SL-102-0012	3/33	0.87 - 1.1	6.2		39 nc			NO	BSL
7440-23-5	Sodium	103	J	11300		mg/kg	MT-SL-102-0012	17/33	85.3 - 98.6	11300					NO	NUT
7440-28-0	Thallium	1.4		2.2	J	mg/kg	MT-SL-602-0509	4/33	0.99 - 2	2.2		0.52 nc			YES	ASL
7440-52-2	Vanadium	2.6		68.6		mg/kg	MT-SL-602-0509	31/33	0.64 - 0.64	68.6		55 nc			YES	ASL
7440-66-6	Zinc	12		330		mg/kg	MT-SL-702-0011	31/33	14.8 - 16.1	330		2300 nc			NO	BSL
18540-29-9	Chromium VI	3	J	28		mg/kg	MT-SO-A6-OVCOMP	2/33	2 - 10.9	28		30 ca**			NO	BSL
18496-25-6	Sulfide	8.8		300	J	mg/kg	MT-SL-402-0311, MT-SL-704-0207-AVG	20/33	5.1 - 16.6	300					NO	NTX

NOTES:

(1) Minimum/maximum detected concentration

(2) N/A - Refer to supporting information for background discussion.

Background values are the maximum of off-site background concentrations.

(3) Region IX PRG residential soil November 2000. Region IX PRGs for non-carcinogens have been adjusted by a factor of 0.1 to correspond to an HI of

(4) Rationale Codes Selection Reason: Infrequent Detection but Associated Historically (HIST)

Frequent Detection (FD)

Toxicity Information Available (TX)

Above Screening Levels (ASL)

Deletion Reason:

Infrequent Detection (IFD)

Background Levels (BKG)

No Toxicity Information (NTX)

Essential Nutrient (NUT)

Below Screening Level (BSL)

EPA Region I does not advocate quantitative risk evaluation of this contaminant.(EPA I)

Definitions

N/A = Not Applicable

SQL = Sample Quantitation Limit

COPC = Chemical of Potential Concern

ARAR/TBC = Applicable or Relevant and Appropriate Requirement/To Be Considered

MCL = Federal Maximum Contaminant Level

SMCL = Secondary Maximum Contaminant Level

J = Estimated Value

ca = Carcinogenic

ca* = Carcinogenic where nc < 100X ca

ca** = Carcinogenic where nc < 10X ca

nc = Non-Carcinogenic

EB = present in equipment blank

nc_1 = Region IX PRG for this non-carcinogen was based on a ceiling limit or saturation

The value shown is 1/10 of the Region IX risk-based PRG

*Since very few samples were collected from only 0 to 10 feet bgs and many of the samples were composites of materials from a wide range of depths, the "all soil" dataset includes any sample with a top depth of less than 10 feet bgs. Many of the samples in this dataset actually extend to depths greater than 10 feet bgs.

TABLE 3

CANCER RISK SUMMARY
FUTURE RESIDENTIAL EXPOSURE ALL SOIL/SLUDGE AREAS 1-7**
FINAL ENGINEERING EVALUATION/COST ANALYSIS
MOHAWK TANNERY SITE
NASHUA, NEW HAMPSHIRE

COPCs	EPC mg/kg	Max or UCL	Location of Maximum detected Concentration	Oral ABS ¹	Source	Dermal ABS ^{1,2}	Oral Exposure Factor d ⁻¹	Dermal Exposure Factor d ⁻¹	CSFadm ³ mg/kg-d	GI ABS used in toxicity study ⁴	CSFabs ⁵ mg/kg-d	Ingestion Cancer Risk	Dermal Cancer Risk	Total Cancer Risk
1,4-Dichlorobenzene	1	95%UCL		*		0.1	6.69E-07	2.11E-07	2.40E-02	1.00E+00	2.40E-02	1.61E-08	5.07E-09	2.11E-08
Chlorobenzene	1.7	95%UCL		*		0.1	6.69E-07	2.11E-07		1.00E+00				
4-Methylphenol	1300	Max		*		0.1	6.69E-07	2.11E-07		1.00E+00				
Benzo(a)Pyrene	0.66	Max		*		0.13	6.69E-07	2.75E-07	7.30E+00	1.00E+00	7.30E+00	3.22E-06	1.32E-06	4.55E-06
2-Methylnaphthalene	21	Max		*		0.13	6.69E-07	2.75E-07		1.00E+00				
Naphthalene	81	Max		*		0.13	6.69E-07	2.75E-07		1.00E+00				
Pentachlorophenol	120	95%UCL		*		0.25	6.69E-07	5.28E-07	1.20E-01	1.00E+00	1.20E-01	9.64E-06	7.61E-06	1.72E-05
Aroclor 1242	0.028	95%UCL		*		0.14	6.69E-07	2.96E-07	2.00E+00	1.00E+00	2.00E+00	3.75E-08	1.66E-08	5.40E-08
Dioxin TEQ	0.0028	Max		0.5	6	0.03	3.35E-07	6.34E-08	1.50E+05	1.00E+00	1.50E+05	1.31E-04	2.47E-05	1.55E-04
Antimony	506	95%UCL		*			6.69E-07			1.50E-01				
Arsenic	8.6	95%UCL		1	7	0.03	6.69E-07	6.34E-08	1.50E+00	1.00E+00	1.50E+00	8.63E-06	8.18E-07	9.45E-06
Barium	154	95%UCL		*			6.69E-07			7.00E-02				
Cadmium	0.78	95%UCL		*		0.001	6.69E-07	2.11E-09		2.50E-02				
Chromium	67800	Max		*			6.69E-07			1.30E-02				
Lead	67.6	95%UCL		*			6.69E-07							
Manganese	1810	95%UCL		*			6.69E-07			4.00E-02				
Mercury	0.76	95%UCL		*			6.69E-07			1.00E+00				
Thallium	0.81	95%UCL		*			6.69E-07			1.00E+00				
Vanadium	32.1	95%UCL		*			6.69E-07			2.60E-02				
														1.87E-04

NOTES:

Age-Adjusted Ingestion Rate = ((200 mg/d * 6 y)/15 kg) + ((100 mg/d * 24 y)/70 kg) = 114 mg-y/kg-d

Age-Adjusted Dermal Contact Rate = ((2800 cm² * 0.2 mg/cm²-ev * 6 y)/15 kg) + ((5700 cm² * 0.07 mg/cm²-ev * 24 y)/70 kg) = 360 mg-y/kg-event

Oral Exposure Factor = Age-adjusted Ingestion Rate * Fraction Ingested * Exposure Frequency * ABS_{oral} * Conversion Factor / Averaging Time
= (114 mg-y/kg-d * 1.0 * 150 d/y * ABS_{oral} * 10-6 kg/mg)/(70 y * 365 d/y)

Dermal Exposure Factor = Age-adjusted Dermal Contact Rate * Exposure Frequency * ABS_{dermal} * Conversion Factor / Averaging Time
= (360 mg-y/kg-ev * 1 ev/d * 150 d/y * ABS_{dermal} * 10-6 kg/mg)/(70 y * 365 d/y)

CSFabs = CSFadm / GI ABS used in toxicity study

Cancer Risk = EPC * Exposure Factor * CSF

1 Oral ABS and Dermal ABS are absorption factors based on exposures to soils.

2 Table 3.4 US EPA, 2001 RAGS E, Dermal Risk Assessment Guidance.

3 Administered CSFs are used in conjunction with administered oral intakes when oral soil absorption factors are not available.

4 Table 4.1 US EPA, 2001 RAGS E, Dermal Risk Assessment Guidance. These values represent absorption factors for the route of administration used in the toxicity study, generally food or water.

5 Absorbed CSFs are used in conjunction with absorbed intakes when soil absorption factors are available for the route of exposure.

6 Personal communication with A. Burke.

7 USEPA Office of Health and Environmental Assessment, Washington, DC, Relevant Absorption Factors for Risk Assessment, Review Draft, September, 1993.

* At this time there is insufficient data to develop a gastrointestinal absorption value for oral exposure to these compounds from soil. Thus it is assumed that the gastrointestinal absorption from the oral soil route is equal to the gastrointestinal absorption in the toxicity study. As a result the exposure dose-oral for these compounds is combined with the CSFadministered. When oral GI soil absorption data becomes available for these compounds this information can be used to adjust the exposure dose-oral to an absorbed dose and justify the combination of this variable with an absorbed CSF.

** Since very few samples were collected from only 0 to 10 feet bgs and many of the samples were composites of materials from a wide range of depths, the "all soil" dataset includes any sample with a top depth of less than 10 feet bgs. Many of the samples in this dataset actually extend to depths greater than 10 feet bgs.

TABLE 4
NONCANCER RISK SUMMARY
FUTURE RESIDENTIAL EXPOSURE ALL** SOIL/SLUDGE AREAS 1-7
FINAL ENGINEERING EVALUATION/COST ANALYSIS
MOHAWK TANNERY SITE
NASHUA, NEW HAMPSHIRE

COPCs	EPC mg/kg	Max or UCL	Oral ABS ¹	Source	Dermal ABS ^{1,2}	Oral Exposure Factor d ⁻¹	Dermal Exposure Factor d ⁻¹	RfDadm ³ mg/kg-d	GI ABS used in toxicity study ⁴	RfDabs ⁵ mg/kg-d	Ingestion Hazard Index	Dermal Hazard Index	Total Hazard Index
1,4-Dichlorobenzene	1	95%UCL	*		0.1	5.48E-06	1.53E-06	3.00E-02	1.00E+00	3.00E-02	1.83E-04	5.11E-05	2.34E-04
Chlorobenzene	1.7	95%UCL	*		0.1	5.48E-06	1.53E-06	2.00E-02	1.00E+00	2.00E-02	4.66E-04	1.30E-04	5.96E-04
4-Methylphenol	1300	Max	*		0.1	5.48E-06	1.53E-06	5.00E-03	1.00E+00	5.00E-03	1.42E+00	3.99E-01	1.82E+00
Benzo(a)Pyrene	0.66	Max	*		0.13	5.48E-06	1.99E-06		1.00E+00				
2-Methylnaphthalene	21	Max	*		0.13	5.48E-06	1.99E-06	2.00E-02	1.00E+00	2.00E-02	5.75E-03	2.09E-03	7.85E-03
Naphthalene	61	Max	*		0.13	5.48E-06	1.99E-06	2.00E-02	1.00E+00	2.00E-02	1.67E-02	6.08E-03	2.28E-02
Pentachlorophenol	120	95%UCL	*		0.25	5.48E-06	3.84E-06	3.00E-02	1.00E+00	3.00E-02	2.19E-02	1.53E-02	3.73E-02
Total Aroclors	0.028	95%UCL	*		0.14	5.48E-06	2.15E-06	2.00E-05	1.00E+00	2.00E-05	1.67E-03	3.01E-03	1.07E-02
Dioxin TEQ	0.0026	Max	0.5	6	0.03	2.74E-06	4.60E-07		1.00E+00				
Antimony	506	95%UCL	*			5.48E-06		4.00E-04	1.50E-01	6.00E-05	6.93E+00		6.93E+00
Arsenic	8.6	95%UCL	1	7	0.03	5.48E-06	4.60E-07	3.00E-04	1.00E+00	3.00E-04	1.57E-01	1.32E-02	1.70E-01
Barium	154	95%UCL	*			5.48E-06		7.00E-02	7.00E-02	4.90E-03	1.21E-02		1.21E-02
Cadmium	0.78	95%UCL	*		0.001	5.48E-06	1.53E-08	5.00E-04	2.50E-02	1.25E-05	8.55E-03	9.57E-04	9.51E-03
Chromium	67800	Max	*			5.48E-06		1.50E+00	1.30E-02	1.95E-02	2.48E-01		2.48E-01
Lead	67.6	95%UCL	*			5.48E-06							
Manganese	1810	95%UCL	*			5.48E-06		7.00E-02	4.00E-02	2.80E-03	1.42E-01		1.42E-01
Mercury	0.76	95%UCL	*			5.48E-06		3.00E-04	1.00E+00	3.00E-04	1.39E-02		1.39E-02
Thallium	0.81	95%UCL	*			5.48E-06		6.60E-05	1.00E+00	6.60E-05	6.72E-02		6.72E-02
Vanadium	32.1	95%UCL	*			5.48E-06		7.00E-03	2.60E-02	1.82E-04	2.51E-02		2.51E-02
													9.52E+00

NOTES:

Oral Exposure Factor = Ingestion Rate * Fraction Ingested * Exposure Frequency * Exposure Duration * ABS_{oral} * Conversion Factor/BW * Averaging Time

= (200 mg/d * 1.0 * 150 d/y * 6 y * ABS_{oral} * 10-6 kg/mg)/(15 kg * 6 y * 365 d/y)

Dermal Exposure Factor = Surface Area * Soil-to-skin Adherence Factor * Exposure Frequency * Exposure Duration * ABS_{dermal} * Conversion Factor/BW * Averaging Time

= (2800 cm² * 0.2 mg/cm²-ev * 1 ev/d * 150 d/y * 6 y * ABS_{dermal} * 10-6 kg/mg)/(15 kg * 6 y * 365 d/y)

RfDabs = RfDadm * GI ABS used in toxicity study

HI = (EPC * Exposure Factor)/RfD

1 Oral ABS and Dermal ABS are absorption factors based on exposures to soils.

2 Table 3-4 US EPA, 2001 RAGS E, Dermal Risk Assessment Guidance

3 Administered RfDs are used in conjunction with administered oral intakes when oral soil absorption factors are not available

4 Table 4-1 US EPA, 2001 RAGS E, Dermal Risk Assessment Guidance. These values represent absorption factors for the route of administration used in the study. For example, if the route of exposure is ingestion, then the GI absorption factor is used.

5 Absorbed RfDs are used in conjunction with absorbed intakes when soil absorption factors are available for the route of exposure

6 Personal communication with A. Burke.

7 USEPA Office of Health and Environmental Assessment, Washington, DC, Relevant Absorption Factors for Risk Assessment, Review Draft, September, 1993.

* At this time there is insufficient data to develop a gastrointestinal absorption value for oral exposure to these compounds from soil. Thus it is assumed that the gastrointestinal absorption factor from the oral-soil route is equal to the gastrointestinal absorption in the toxicity study. As a result the exposure dose-oral for these compounds is combined with the GI absorption factor. When oral GI soil absorption data becomes available for these compounds this information can be used to adjust the exposure dose-oral to an absorbed dose and justify the combination of this variable with an absorbed CSF.

** Since very few samples were collected from only 0 to 10 feet bgs and many of the samples were composites of materials from a wide range of depths, it is assumed that the data represent any sample with a top depth of less than 10 feet bgs. Many of the samples in this dataset actually extend to depths greater than 10 feet bgs.

TABLE 5
ESTIMATED SLUDGE/WASTE AND OVERLYING SOIL VOLUMES
FINAL ENGINEERING EVALUATION/COST ANALYSIS
MOHAWK TANNERY SITE
NASHUA, NEW HAMPSHIRE

Disposal Area	Estimated Area of Sludge/Waste (SF)	Estimated Thickness of Sludge/Waste (FT)	Estimated Volume of Sludge/Waste (CF)	Estimated Volume of Sludge/Waste (CY)	Estimated Thickness of Overlying Soil (FT)	Estimated Volume of Overlying Soil (CF)	Estimated Volume of Overlying Soil (CY)
1	40,000	17	680,000	25,185	NA	NA	NA
2	80,000	10	800,000	29,630	3	240,000	8,889
3	2,000	5	10,000	370	2	4,000	148
4	3,000	9	27,000	1,000	2	6,000	222
5	NA	NA	NA	NA	NA	NA	NA
6	3,500	5	17,500	648	2	7,000	259
7	8,000	12	96,000	3,556	0	0	0
TOTAL VOLUME (CY):				60,389			9,519

Notes:

See Section 2.1.3 for assumptions made in the area/thickness/volume estimations for sludge/waste and overlying soil.

Overlying soil estimates evaluate only overlying soil considered practical to separate from underlying sludge/waste during excavation.

SF = Square Feet

FT = Feet

CF = Cubic Feet

CY = Cubic Yards

NA = Not Applicable. Field observations and chemical analysis indicate no sludge or tannery waste present, or no overlying soil.

TABLE 6
 SCREENING OF TECHNOLOGIES AND PROCESS OPTIONS FOR SLUDGE/WASTE
 FINAL ENGINEERING EVALUATION/COST ANALYSIS
 MOHAWK TANNERY SITE
 NASHUA, NEW HAMPSHIRE

GENERAL RESPONSE ACTION	TECHNOLOGY	PROCESS OPTION	DESCRIPTION	SCREENING COMMENTS
Limited Action	Access Restrictions	Fencing	Installation and/or repair of site fencing to restrict access to contaminated areas.	<u>Eliminated</u> as a primary technology because it would not be effective in protecting ecological receptors or environment. However, may be used with other technologies such as on-site landfill to prevent access to a particular area of the site.
	Environmental Monitoring	Environmental Monitoring	Monitoring of groundwater, surface water, and sediment to determine whether contaminants are migrating from site sludge/soil.	<u>Eliminated</u> as a primary technology because it would not be effective in achieving any RAOs. However, may be used to monitor the effectiveness of other technologies such as on-site landfilling.
	Institutional Controls	Deed Restrictions	Administrative action used to restrict future site activities on individual properties. Activities such as excavation or residential development could be restricted under property deeds.	<u>Eliminated</u> . Would not prevent direct contact with overlying soil and/or sludge. Would not protect ecological receptors or the environment or promote restoration of site to residential use.
		Zoning Ordinances	Administrative action by municipality to change permitted use of land to prevent particular types of development such as residential use. Typically applicable to an area, not an individual parcel.	<u>Eliminated</u> . Would not prevent direct contact with overlying soil and/or sludge. Would not protect ecological receptors or the environment or promote restoration of site to residential use.

TABLE 6 (cont.)
 SCREENING OF TECHNOLOGIES AND PROCESS OPTIONS FOR SLUDGE/WASTE
 FINAL ENGINEERING EVALUATION/COST ANALYSIS
 MOHAWK TANNERY SITE
 NASHUA, NEW HAMPSHIRE
 PAGE 2 OF 6

GENERAL RESPONSE ACTION	TECHNOLOGY	PROCESS OPTION	DESCRIPTION	SCREENING COMMENTS
Containment	Horizontal Barriers	Low permeability cap	Clay, asphalt, concrete, or multi-media cover over areas of contamination to prevent direct contact and minimize leaching of contaminants from the sludge/waste into groundwater and subsequent discharge to the Nashua River.	<u>Eliminated.</u> Not effective for preventing the release of contaminants to environment due to sludge/waste located below the water table in Areas 1 and 2. May not be viable in floodplain area (Area 2); would alter flood capacity.
		Permeable cover	Crushed stone or vegetative cover to prevent direct contact and minimize erosion and surface migration of sludge/waste contaminants.	<u>Eliminated.</u> Not effective for preventing the release of contaminants to environment because infiltration not restricted and sludge/waste located below the water table in Areas 1 and 2. May not be viable in floodplain area (Area 2); would alter flood capacity.
	Vertical Barriers	Slurry Walls	Trench filled with clay or cement slurry to form low permeability wall to restrict horizontal migration of sludge/waste contaminants.	<u>Eliminated.</u> Not effective for reducing contaminant leaching from unsaturated sludge/waste and limited effectiveness in a flood area (Area 2). Would not prevent direct contact with overlying soil and/or sludge.
		Grout Injection	Use of pressure-injected cement grout to form impermeable or semi-permeable barrier to restrict horizontal migration of sludge/waste contaminants.	<u>Eliminated.</u> Not effective for reducing contaminant leaching from unsaturated sludge/waste and limited effectiveness in a flood area (Area 2). Would not prevent direct contact with overlying soil and/or sludge.

TABLE 6 (cont.)
SCREENING OF TECHNOLOGIES AND PROCESS OPTIONS FOR SLUDGE/WASTE
FINAL ENGINEERING EVALUATION/COST ANALYSIS
MOHAWK TANNERY SITE
NASHUA, NEW HAMPSHIRE
PAGE 3 OF 6

GENERAL RESPONSE ACTION	TECHNOLOGY	PROCESS OPTION	DESCRIPTION	SCREENING COMMENTS
Containment (cont'd)	Vertical Barriers (cont'd)	Sheet Piling	Steel or precast concrete sheet piles used to form barrier to restrict horizontal migration of contaminants	<u>Eliminated</u> . Not effective for reducing contaminant leaching from unsaturated sludge/waste and limited effectiveness in a flood area (Area 2). Would not prevent direct contact with overlying soil and/or sludge.
In-Situ Treatment	Thermal Treatment	In-Situ Vitrification	An electrical network is used to melt contaminated soils in-place. Metals are immobilized within a vitreous mass, organics are destroyed by pyrolysis.	<u>Eliminated</u> . Not suitable due to high moisture content of sludge and presence of saturated sludge. Would require excessive energy consumption (and cost) to be effective.
		In-Situ Thermal Desorption	Use of electrically heated in-situ blanket and/or well system to volatilize and oxidize organic contaminants.	<u>Eliminated</u> . Not applicable to inorganic site contaminants of concern. Effectiveness for organics is limited by presence of fine-grained constituents, which increase reaction time due to binding of contaminants.
	Physical/ Chemical Treatment	In-Situ Solidification/ Stabilization	Mixing equipment is used to apply treatment reagents to contaminated soils. Contaminants are physically and/or chemically immobilized in a cement-like mass.	<u>Eliminated</u> . Not applicable to organic site contaminants of concern. Solidification/ stabilization of sludge below the water table would be difficult to implement effectively. May not be viable in floodplain area (Area 2); would alter flood capacity.

TABLE 6 (cont.)
SCREENING OF TECHNOLOGIES AND PROCESS OPTIONS FOR SLUDGE/WASTE
FINAL ENGINEERING EVALUATION/COST ANALYSIS
MOHAWK TANNERY SITE
NASHUA, NEW HAMPSHIRE
PAGE 4 OF 6

GENERAL RESPONSE ACTION	TECHNOLOGY	PROCESS OPTION	DESCRIPTION	SCREENING COMMENTS
In-Situ Treatment (cont'd)	Physical/ Chemical Treatment (cont.)	Soil Flushing	In-situ process which employs a water-based extraction fluid and an injection/extraction well system to flush contaminants.	<u>Eliminated</u> . Less effective in low permeability materials such as site sludge. Not suitable in Areas 1, 2, and 3 due to site hydrogeology (proximity to river). May be difficult to control and direct flow of extraction fluid.
	Biological Treatment	In-Situ Enhanced Bioremediation	Indigenous or inoculated microorganisms (e.g., fungi, bacteria, and other microbes) degrade (metabolize) organic contaminants found in soil/sludge, converting them to less harmful end products. Water, nutrients, and/or electron receptors (such as oxygen or nitrate) may be added to enhance degradation. Biodegradation may be aerobic or anaerobic depending on contaminants present and soil/sludge matrix.	<u>Eliminated</u> . Not applicable to inorganic site contaminants of concern. Bioremediation of organic site contaminants may be possible, but process would likely be difficult to enhance and control due to low permeability sludge matrix and close proximity to river.
Ex-Situ Treatment	Immobilization	Solidification/ Stabilization	Mixing of excavated contaminated materials with treatment reagents to physically and/or chemically bind and decrease the mobility of contaminants. Common treatment reagents include cement, pozzolanic materials, thermoplastics, polymers, and asphalt.	<u>Potentially applicable</u> for secondary treatment of residuals from thermal treatment of sludge/soil. <u>Eliminated</u> as a primary treatment option due to inability to effectively treat organic site contaminants of concern.
	Thermal Treatment	Vitrification	Melting of wastes to entrain contaminants in a stable vitreous residual.	<u>Eliminated</u> . Not suitable due to high moisture content of site sludge. Not applicable to wastes containing >25% moisture content (causes excessive fuel consumption).

TABLE 6 (cont.)

SCREENING OF TECHNOLOGIES AND PROCESS OPTIONS FOR SLUDGE/WASTE

FINAL ENGINEERING EVALUATION/COST ANALYSIS

MOHAWK TANNERY SITE

NASHUA, NEW HAMPSHIRE

PAGE 5 OF 6

GENERAL RESPONSE ACTION	TECHNOLOGY	PROCESS OPTION	DESCRIPTION	SCREENING COMMENTS
Ex-Situ Treatment (cont'd)	Thermal Treatment (cont.)	Thermal Desorption	Contaminated soils are treated at elevated temperatures to volatilize organics, which are subsequently removed and captured or destroyed.	<u>Eliminated</u> . Effectiveness is reduced by binding of contaminants to fine particles in sludge. Not applicable to inorganic site contaminants of concern. Applicability to dioxin waste is limited.
		Incineration	Contaminated soils are heated extremely high temperatures where organic compounds are destroyed through oxidation.	<u>Eliminated</u> as on-site treatment alternative. Not implementable in densely developed residential area. <u>Retained</u> as an off-site treatment alternative.
	Physical/ Chemical Treatment	Soil Washing	Water-based process in which soils are separated into coarse and fine fractions to reduce the volume of materials requiring intensive treatment or disposal.	<u>Eliminated</u> . Complex waste mixtures (e.g., metals with organics) make soil washing difficult and costly. Abundance of fine particles in sludge (onto which contaminants tend to bind) would hinder volume reduction during sludge separation, rendering soil washing ineffective.
		Solvent Extraction	Desorption of contaminants through washing with a solvent solution.	<u>Eliminated</u> . Complex waste mixtures (e.g., metals with organics) make formulating an effective washing fluid difficult and costly. Effectiveness reduced by binding of contaminants to fine particles.

TABLE 6 (cont.)
 SCREENING OF TECHNOLOGIES AND PROCESS OPTIONS FOR SLUDGE/WASTE
 FINAL ENGINEERING EVALUATION/COST ANALYSIS
 MOHAWK TANNERY SITE
 NASHUA, NEW HAMPSHIRE
 PAGE 6 OF 6

GENERAL RESPONSE ACTION	TECHNOLOGY	PROCESS OPTION	DESCRIPTION	SCREENING COMMENTS
Ex-Situ Treatment (cont'd)	Biological Treatment	Slurry Phase Biological Treatment	Sludge is combined with water and other additives to create a slurry that is mixed into a bioreactor to keep solids suspended and microorganisms in contact with the sludge contaminants. Oxygen, nutrients, and microorganisms may be added to the bioreactor to optimize the rate of biodegradation. Upon completion of the process, the slurry is dewatered and the treated solids are disposed of.	<u>Eliminated</u> . Not applicable to inorganic site contaminants of concern. Abundance of fine constituents in site sludge would make mixing and aeration difficult and not cost-effective.
Disposal	Landfill	Off-Site Landfill	Transport and disposal of untreated or treated sludge/waste off-site to an approved hazardous waste or solid waste landfill.	<u>Retained</u> .
		On-Site Landfill	Disposal of sludge/waste in a specially constructed hazardous waste or solid waste landfill on-site.	<u>Retained</u> .
	Land Disposal/ Backfill	On-Site Disposal	On-site use of treated soil/sludge as fill material.	<u>Eliminated</u> . Not feasible for materials that are treated off-site.

TABLE 7
COMPARATIVE ANALYSIS OF REMOVAL ACTION ALTERNATIVES
FINAL ENGINEERING EVALUATION/COST ANALYSIS
MOHAWK TANNERY SITE
NASHUA, NEW HAMPSHIRE

CRITERION	ALTERNATIVE 1: EXCAVATION and OFF-SITE DISPOSAL	ALTERNATIVE 2: CONSOLIDATION into ON-SITE LANDFILL	ALTERNATIVE 3: EXCAVATION, OFF-SITE TREATMENT, and DISPOSAL
EFFECTIVENESS			
Overall Protection of Human Health and the Environment	Would meet NTCRA removal action objectives and be consistent with long-term remedial actions.	Would meet NTCRA removal action objectives, but would be less acceptable than Alternatives 1 and 3 in meeting the future residential use RAO.	Same as Alternative 1.
	Would prevent direct contact with and ingestion of contaminated sludge/waste, prevent contaminant leaching to groundwater, and reduce erosion and off-site migration of contamination.	Same as Alternative 1 provided that the landfill is properly operated and maintained and is not allowed to erode or degrade.	Same as Alternative 1.
	No unacceptable short-term impacts would be anticipated.	Same as Alternative 1.	Same as Alternative 1.
Compliance with ARARs	Discharge of dewatering effluent to the Nashua sewer system would be implemented to comply with all federal, state and local requirements.	Same as Alternative 1.	Same as Alternative 1.
	Would comply with federal and state floodplain regulations.	Same as Alternative 1.	Same as Alternative 1.
	Would comply with state testing and waste identification regulations.	Same as Alternative 1.	Same as Alternative 1.

TABLE 7 (cont.)
COMPARATIVE ANALYSIS OF REMOVAL ACTION ALTERNATIVES
FINAL ENGINEERING EVALUATION/COST ANALYSIS
MOHAWK TANNERY SITE
NASHUA, NEW HAMPSHIRE
PAGE 2 OF 8

CRITERION	ALTERNATIVE 1: EXCAVATION and OFF-SITE DISPOSAL	ALTERNATIVE 2: CONSOLIDATION into ON-SITE LANDFILL	ALTERNATIVE 3: EXCAVATION, OFF-SITE TREATMENT, and DISPOSAL
EFFECTIVENESS (cont.)			
Compliance with ARARs (cont.)	Would comply with state regulations for generators of hazardous waste.	Same as Alternative 1.	Same as Alternative 1.
	Would comply with federal and state regulations for solid and hazardous waste storage facilities.	Same as Alternative 1.	Same as Alternative 1.
	Would comply with state air pollution control regulations.	Same as Alternative 1.	Same as Alternative 1.
	Would comply with state solid waste regulations.	Same as Alternative 1.	Same as Alternative 1.
Long-term Effectiveness and Permanence	No residual risks, above selected PRGs, would remain at the site.	Residual risk would exist in the form of contaminated sludge/waste in the on-site landfill. If degradation or failure of the engineered landfill liner system were to occur, contaminants could pose a threat to the environment and human and ecological receptors.	Same as Alternative 1.

TABLE 7 (cont.)
COMPARATIVE ANALYSIS OF REMOVAL ACTION ALTERNATIVES
FINAL ENGINEERING EVALUATION/COST ANALYSIS
MOHAWK TANNERY SITE
NASHUA, NEW HAMPSHIRE
PAGE 3 OF 8

CRITERION	ALTERNATIVE 1: EXCAVATION and OFF-SITE DISPOSAL	ALTERNATIVE 2: CONSOLIDATION into ON-SITE LANDFILL	ALTERNATIVE 3: EXCAVATION, OFF-SITE TREATMENT, and DISPOSAL
EFFECTIVENESS (cont.)			
Long-term Effectiveness and Permanence (cont.)	Would be effective in the long term and would be permanent.	Would be effective in the long term and would be permanent provided that the landfill system is properly operated and maintained. Long-term operation and maintenance of the landfill is required to ensure Alternative 2's continued effectiveness.	Same as Alternative 1.
Reduction of Toxicity, Mobility, or Volume Through Treatment	No treatment involved under Alternative 1.	No treatment involved under Alternative 2.	Off-site treatment performed under Alternative 3 (incineration) would reduce the toxicity and volume of contamination in sludge/waste through treatment. Stabilization of treatment residuals (if necessary) would reduce the mobility of contaminants in sludge/waste residuals.
	Would not satisfy statutory preference for treatment.	Same as Alternative 1.	Would satisfy statutory preference for treatment.

TABLE 7 (cont.)
COMPARATIVE ANALYSIS OF REMOVAL ACTION ALTERNATIVES
FINAL ENGINEERING EVALUATION/COST ANALYSIS
MOHAWK TANNERY SITE
NASHUA, NEW HAMPSHIRE
PAGE 4 OF 8

CRITERION	ALTERNATIVE 1: EXCAVATION and OFF-SITE DISPOSAL	ALTERNATIVE 2: CONSOLIDATION into ON-SITE LANDFILL	ALTERNATIVE 3: EXCAVATION, OFF-SITE TREATMENT, and DISPOSAL
EFFECTIVENESS (cont.)			
Short-term Effectiveness	Limited impacts to community, on-site workers, and environment.	Same as Alternative 1.	Same as Alternative 1.
	Increase in heavy vehicle traffic in site vicinity anticipated. Would be addressed through traffic control and coordination with community and state agencies.	Comparable to Alternative 1. Alternative 2 would require less truck traffic to and from the site since excavated sludge/waste would not be transported off of the site. However, duration of site work would be longer.	Same as Alternative 1.
	Potential for sulfide odor and dust emissions (metals, SVOCs, dioxins) during excavation. Emissions monitoring and control measures would prevent or minimize potential problems.	Same as Alternative 1. Emissions issues could be slightly more problematic due to additional onsite handling of sludge/waste during landfill construction.	Same as Alternative 1.
	Increased noise due to site and construction activities. Would coordinate with community to lessen impacts.	Same as Alternative 1.	Same as Alternative 1.
	Estimated duration of on-site removal activities: 11 months.	Estimated duration of on-site removal activities: 16 months.	Estimated duration of on-site removal activities: 11 months.

TABLE 7 (cont.)
COMPARATIVE ANALYSIS OF REMOVAL ACTION ALTERNATIVES
FINAL ENGINEERING EVALUATION/COST ANALYSIS
MOHAWK TANNERY SITE
NASHUA, NEW HAMPSHIRE
PAGE 5 OF 8

CRITERION	ALTERNATIVE 1: EXCAVATION and OFF-SITE DISPOSAL	ALTERNATIVE 2: CONSOLIDATION into ON-SITE LANDFILL	ALTERNATIVE 3: EXCAVATION, OFF-SITE TREATMENT, and DISPOSAL
IMPLEMENTABILITY			
Technical Feasibility	Excavation of sludge/waste below the water table could be technically difficult and adversely impact production rates, but would be technically feasible. Excavation of wastes in vicinity of sewer interceptor would require extra caution, but would be feasible. All other aspects of the Alternative would be readily implementable.	Excavation difficulties same as Alternative 1. May be difficult to design and construct on-site landfill that would contain large volume of waste, and be aesthetically acceptable to nearby residents.	Same as Alternative 1.
	Additional response actions could be implemented, if needed.	Similar to Alternative 1, but additional actions may be more difficult and costly if actions involve modifying the on-site landfill.	Same as Alternative 1.
	Would contribute to the site's long-term remedial action.	Comparable to Alternative 1. Contaminated sludge/waste would remain on site, but would be contained by the landfill liner and cover systems.	Same as Alternative 1.

TABLE 7 (cont.)
COMPARATIVE ANALYSIS OF REMOVAL ACTION ALTERNATIVES
FINAL ENGINEERING EVALUATION/COST ANALYSIS
MOHAWK TANNERY SITE
NASHUA, NEW HAMPSHIRE
PAGE 6 OF 8

CRITERION	ALTERNATIVE 1: EXCAVATION and OFF-SITE DISPOSAL	ALTERNATIVE 2: CONSOLIDATION into ON-SITE LANDFILL	ALTERNATIVE 3: EXCAVATION, OFF-SITE TREATMENT, and DISPOSAL
IMPLEMENTABILITY (cont.)			
Administrative Feasibility	No permits for on-site work needed.	Approval process for the construction of the on-site landfill may be difficult and time-consuming.	Same as Alternative 1.
	<p><u>Alternative 1A:</u> Administrative feasibility for off-site disposal of non-hazardous waste would be high.</p> <p><u>Alternative 1B:</u> Off-site disposal of Area 1 sludge at a RCRA C facility would not provide any additional administrative feasibility issues beyond those for Alternative 1A.</p> <p><u>Alternative 1C:</u> Administrative issues related to the disposal of Area 1 sludge at a Canadian landfill would be slightly more difficult than those for Alternatives 1A and 1B.</p>	<p><u>Alternatives 2A and 2B:</u> Since no off-site disposal of sludge/waste would be performed under Alternatives 2A and 2B, no administrative action would be required for disposal.</p> <p><u>Alternative 2C:</u> Administrative issues related to the off-site disposal of Area 1 sludge at a Canadian landfill would make Alternative 2C more difficult to implement from an administrative standpoint.</p>	<p><u>Alternative 3-US:</u> Administrative actions required for off-site treatment and disposal of non-hazardous or hazardous waste at an American facility would not be difficult.</p> <p><u>Alternative 3-CAN:</u> Administrative actions required for the off-site treatment and disposal of sludge/waste at a Canadian incinerator would be more difficult to implement than for Alternative 3-US.</p>
	Administrative approval and analytical data required for discharge of dewatering effluent to the city sewer system.	Same as Alternative 1.	Same as Alternative 1.
	Would require coordination with NHDES and the City of Nashua for construction of the site access road and for traffic controls on Broad Street.	Same as Alternative 1.	Same as Alternative 1.

TABLE 7 (cont.)
COMPARATIVE ANALYSIS OF REMOVAL ACTION ALTERNATIVES
FINAL ENGINEERING EVALUATION/COST ANALYSIS
MOHAWK TANNERY SITE
NASHUA, NEW HAMPSHIRE
PAGE 7 OF 8

CRITERION	ALTERNATIVE 1: EXCAVATION and OFF-SITE DISPOSAL	ALTERNATIVE 2: CONSOLIDATION into ON-SITE LANDFILL	ALTERNATIVE 3: EXCAVATION, OFF-SITE TREATMENT, and DISPOSAL
IMPLEMENTABILITY (cont.)			
Availability of Services and Materials	Qualified contractors for all on-site activities would be available for competitive bidding.	Same as Alternative 1.	Same as Alternative 1.
	Qualified national off-site disposal facilities (RCRA D, RCRA C, and in Canada) capable and willing to receive dioxin-containing waste have been identified during preparation of the EE/CA. Final acceptability of site sludge/waste at any facility would be contingent on the results of waste characterization samples collected during the removal action.	No off-site disposal of sludge/waste would be necessary under Alternatives 2A and 2B. Qualified Canadian facilities have been identified that would be capable of receiving dioxin-containing waste should Alternative 2C be implemented.	Qualified national and international off-site incineration facilities capable and willing to receive dioxin-bearing wastes have been identified during preparation of the EE/CA. Fewer facilities are available than for Alternative 1, particularly in United States. Final acceptability of site sludge/waste at any facility would be contingent on the results of waste characterization samples collected during the removal action.
State Acceptance	To be addressed after close of public comment period.	Same as Alternative 1.	Same as Alternative 1
Community Acceptance	To be addressed after close of public comment period.	Same as Alternative 1.	Same as Alternative 1.

TABLE 7 (cont.)
COMPARATIVE ANALYSIS OF REMOVAL ACTION ALTERNATIVES
FINAL ENGINEERING EVALUATION/COST ANALYSIS
MOHAWK TANNERY SITE
NASHUA, NEW HAMPSHIRE
PAGE 8 OF 8

CRITERION	ALTERNATIVE 1: EXCAVATION and OFF-SITE DISPOSAL	ALTERNATIVE 2: CONSOLIDATION into ON-SITE LANDFILL	ALTERNATIVE 3: EXCAVATION, OFF-SITE TREATMENT, and DISPOSAL
COST			
Capital Costs	Alternative 1A: \$14,939,000 Alternative 1B: \$20,428,000 Alternative 1C: \$22,819,000	Alternative 2A: \$5,572,000 Alternative 2B: \$5,572,000 Alternative 2C: \$18,428,000	Alternative 3-US: \$69,715,000 Alternative 3-CAN: \$50,152,000
Annual PRSC Costs	Years 1-2: \$4,000 Years 3-30: \$0	Years 1-2: \$155,275 Years 3-5: \$60,075 Years 6-30: \$37,275	Years 1-2: \$4,000 Years 3-30: \$0
Total Present Worth Costs	Alternative 1A: \$14,946,000 Alternative 1B: \$20,435,000 Alternative 1C: \$22,826,000	Alternative 2A: \$6,300,000 Alternative 2B: \$6,300,000 Alternative 2C: \$19,156,000	Alternative 3-US: \$69,722,000 Alternative 3-CAN: \$50,160,000

TABLE 8
SELECTION OF PRELIMINARY REMEDIATION GOALS
FINAL ENGINEERING EVALUATION/COST ANALYSIS
MOHAWK TANNERY SITE
NASHUA, NEW HAMPSHIRE

Contaminants of Concern ¹	Units	PRG ¹ based on CR=10-6	PRG ¹ based on CR=10-5	PRG ¹ based on CR=10-4	PRG ¹ based on HI=0.1	PRG ¹ based on HI=1.0	NH RCMP Background Soil Conc. ²	NH S-1 ³	Proposed PRG ⁴
Benzo(a)Pyrene	ug/kg	145	1450	14500				700	145
Pentachlorophenol	ug/kg	6958	69580	695800				3300	6958
4-Methylphenol	ug/kg				71289	712890		5000	712891
Dioxin TEQ	ng/kg	16.7*	167*	1670*					1000*
Antimony	mg/kg				7.3	73	1.64	8	73
Arsenic	mg/kg	0.91	9.1	91	5.1	51	11	11	51
Barium	mg/kg				1278	12780		750	12780
Cadmium	mg/kg				8.2	82	1.9	32	82
Chromium [#]	mg/kg				27375	273750	33	1000	273750
Manganese	mg/kg				1278	12775			12775
Vanadium	mg/kg				128	1278			1278

PRG = Preliminary Remediation Goal

CR = Cancer Risk

HI = Hazard Index

- 1 The COCs and risk-based PRGs were determined based on the Streamlined Human Health Risk Evaluation presented in Section 2.4. The COCs include all compounds that have a cancer risk greater than 1.0E-06 or a non-cancer HI greater than 1.0 for any exposure scenario. The risk-based PRGs were calculated based on the future residential exposure scenario. See Section 3.2 and 3.2 for additional details.
 - 2 NHDES RCMP Background Concentrations of Metals in Soil; Section 1.5, Table 1; January 1998, revised April 2001.
 - 3 NHDES RCMP Method 1 Standards for Category S-1 Soil; Section 7.5, Table 3; January 1998, revised April 2001. The NH S-1 standards are presented here for reference; however they were not used in selecting the proposed PRGs because they are non-promulgated criteria used as default standards in cases where a site-specific risk assessment has not been performed. Because a site-specific risk evaluation was conducted for this site, the calculated risk-based PRGs are used in place of the S-1 standards.
 - 4 The proposed PRGs for all contaminants except dioxin TEQ are the lower of the site-specific PRGs calculated for a cancer risk of 1.0E-6 and hazard index of 1.0. If the selected risk-based value is below the NH RCMP background soil concentration, then the background concentration is selected as the proposed value.
- + The proposed PRG for dioxin TEQ is EPA's recommended cleanup goal for residential settings (EPA OSWER Directive 9200.4-26: Approach for Addressing Dioxins in Soil at CERCLA and RCRA Sites, U.S. EPA, 1998). This value is proposed for use pending completion of EPA's comprehensive reassessment of the toxicity of dioxin.
- * The identified PRGs for dioxin TEQs were calculated using the currently available cancer slope factor (CSF) from IRIS (2002). If the CSF proposed in EPA's recently prepared Draft Dioxin Reassessment (1.0E+6) were used to calculate the PRGs the values would be: 2.5 ng/kg for CR=10-6, 25 ng/kg for CR=10-5, and 250 ng/kg for CR=10-4.
- # The PRGs for chromium are based on trivalent chromium because hexavalent chromium was detected at the site only sporadically and at low concentrations (below screening levels).

TABLE 9
CHEMICAL-SPECIFIC ARARs AND TBCs
ALTERNATIVE 1 - EXCAVATION AND OFF-SITE DISPOSAL
FINAL ENGINEERING EVALUATION/COST ANALYSIS
MOHAWK TANNERY SITE
NASHUA, NEW HAMPSHIRE

AUTHORITY	REQUIREMENT	STATUS	REQUIREMENT SYNOPSIS	CONSIDERATION FOR ALTERNATIVE 1
Federal Criteria, Advisories, and Guidance	EPA Region IX Preliminary Remediation Goals (PRGs)	To Be Considered	The Region IX PRGs are generic, risk-based concentrations derived from standardized equations, combining exposure information assumptions and EPA toxicity data. PRGs are typically used for site screening and as initial cleanup goals, if applicable. The Region IX PRGs should be viewed as Agency guidelines rather than legally enforceable standards.	Region IX PRGs were used as preliminary project screening criteria to identify contaminants of potential concern for the human health risk evaluation and EE/CA data evaluation.
	OSWER Directive 9200.4-26, <i>Approaches for Addressing Dioxins in Soil at CERCLA and RCRA Sites</i> (April 13, 1998)	To Be Considered	This Directive provides guidance in establishing cleanup levels for dioxins. It recommends a cleanup goal of 1 µg/kg (ppb) of dioxins (as 2,3,7,8-TCDD TEQ) for soils involving residential exposure scenarios, and a cleanup range of 5 to 20 µg/kg of dioxin (as 2,3,7,8-TCDD TEQ) for commercial and industrial exposure scenarios.	OSWER Directive 9200.4-26 was used as a preliminary project screening criterion for dioxin-contaminated sludge and soil in the data evaluation. The 1 ppb cleanup level is also recommended as the preliminary removal goal for site sludge/waste.
	EPA Human Health Assessment Cancer Slope Factors (CSFs)	To Be Considered	CSFs are developed by EPA for health effects assessments or evaluation by the Human Health Assessment Group. These values present the most up-to-date cancer risk potency information and are used to compute the individual incremental cancer risk resulting from exposure to carcinogens.	CSFs were used to compute the individual cancer risk resulting from exposure to contaminants and in the development of acceptable contaminant levels.
	EPA Risk Reference Doses (RfDs)	To Be Considered	RfDs are dose levels developed by EPA for use in estimating the non-carcinogenic risk resulting from exposure to toxic substances.	RfDs were used to compute the non-carcinogenic risk resulting from exposure to contaminants and in the development of acceptable contaminant levels.

TABLE 9 (cont.)
CHEMICAL-SPECIFIC ARARs AND TBCs
ALTERNATIVE 1 - EXCAVATION AND OFF-SITE DISPOSAL
FINAL ENGINEERING EVALUATION/COST ANALYSIS
MOHAWK TANNERY SITE
NASHUA, NEW HAMPSHIRE
PAGE 2 OF 2

AUTHORITY	REQUIREMENT	STATUS	REQUIREMENT SYNOPSIS	CONSIDERATION FOR ALTERNATIVE 1
State Criteria, Advisories, and Guidance	NH DES RCMP Background Concentrations of Metals in Soil (Subsection 1.5(4)(c), Table 1)	To Be Considered	This table identifies background concentrations of metals that have been observed in New Hampshire soils that can be attributed to natural geological and ecological processes rather than anthropogenic contaminant sources. The values presented in Table 1 are considered representative of non-urban locations in New Hampshire.	NH DES background concentrations of metals were used to assess the source of inorganic constituents that were detected at elevated concentrations in overlying soil at the site. The background concentrations were considered in selection of the recommended PRGs.

TABLE 10
LOCATION-SPECIFIC ARARs AND TBCs
ALTERNATIVE 1 - EXCAVATION AND OFF-SITE DISPOSAL
FINAL ENGINEERING EVALUATION/COST ANALYSIS
MOHAWK TANNERY SITE
NASHUA, NEW HAMPSHIRE

AUTHORITY	REQUIREMENT	STATUS	REQUIREMENT SYNOPSIS	CONSIDERATION FOR ALTERNATIVE 1
Federal Regulatory Requirements	Protection of Wetlands (Executive Order 11990), 40 CFR 6.302(a) and 40 CFR 6, App. A (Policy on Implementing E.O. 11990)	Applicable	Federal agencies are required to minimize the destruction, loss or degradation of wetlands, and the order emphasizes the importance of avoiding new construction or harm to wetlands unless there is no practicable alternative to such construction.	There are no designated wetlands within the boundaries of the removal action. Steps will be taken to protect other wetland areas at the site from indirect impacts.
	Floodplain Management (Executive Order 11988, 40 CFR 6.302(b) and 40 CFR 6, App. A (Policy on Implementing E.O. 11988)	Applicable	Federal agencies are required to avoid impacts associated with the occupancy and modification of a floodplain and avoid support of floodplain development wherever there is a practicable alternative.	Areas 1 and 2 are located within the 100-year floodplain and, thus, work within the floodplain cannot be avoided. Steps will be taken to prevent effects on floodplain capacity.
	RCRA Floodplain Restrictions for Solid Waste Disposal Facilities and Practices (40 CFR 257.3-1)	Relevant and Appropriate	Solid waste practices must not restrict the flow of a 100-year flood, reduce the temporary water storage capacity of the floodplain or result in washout of solid waste, so as to pose a hazard to human life, wildlife, or land or water resources.	Engineering controls will be used during the excavation and stockpiling of sludge/waste to comply with these requirements.
	RCRA Floodplain Restrictions for Hazardous Waste Facilities (40 CFR 264.18(b))	Relevant and Appropriate*	A hazardous waste treatment, storage, or disposal facility located in a 100-year floodplain must be designed, constructed, operated, and maintained to prevent washout or to result in no adverse effects on human health or the environment if washout were to occur.	Some sludge/waste will need to be excavated from areas of the site located within the 100-year floodplain. If the waste is characterized as hazardous, engineering controls will be used to minimize the risk of contaminant migration through washout.

TABLE 10 (cont.)
LOCATION-SPECIFIC ARARs AND TBCs
ALTERNATIVE 1 - EXCAVATION AND OFF-SITE DISPOSAL
FINAL ENGINEERING EVALUATION/COST ANALYSIS
MOHAWK TANNERY SITE
NASHUA, NEW HAMPSHIRE
PAGE 2 OF 2

AUTHORITY	REQUIREMENT	STATUS	REQUIREMENT SYNOPSIS	CONSIDERATION FOR ALTERNATIVE 1
State Regulatory Requirements	Rules Relative to Prevention of Pollution from Dredging, Filling, Mining, Transporting, and Construction (Env-Ws 415)	Applicable	These rules establish criteria for the protection of surface water quality resulting from activities that occur in or on the border of surface water or within a distance of surface water such that direct or immediate degradation may result to water quality.	Alternative 1 will comply with the substantive requirements of this regulation. Alternative 1 will involve erosion and sedimentation controls to prevent impacts to the Nashua River. Site restoration will include measures to prevent alteration of site topography.
	New Hampshire Siting Requirements for Hazardous Waste Facilities (Env-Wm 353.08 and 353.09)	Relevant and Appropriate*	These rules impose restrictions on where hazardous waste facilities can be located, specifically locations near geologic fault areas, or in or near floodplains.	Some sludge/waste will need to be excavated from areas of the site located within the 100-year floodplain. If the waste is characterized as hazardous, engineering controls will be used to minimize the risk of contaminant migration through washout.

* These regulations will be applicable or relevant and appropriate only if the waste is characterized as hazardous.

TABLE 11
ACTION-SPECIFIC ARARs AND TBCs
ALTERNATIVE 1 – EXCAVATION AND OFF-SITE DISPOSAL
FINAL ENGINEERING EVALUATION/COST ANALYSIS
MOHAWK TANNERY SITE
NASHUA, NEW HAMPSHIRE

AUTHORITY	REQUIREMENT	STATUS	REQUIREMENT SYNOPSIS	CONSIDERATION FOR ALTERNATIVE 1
Federal Regulatory Requirements	CWA - Pre-treatment Regulations (40 CFR 403)	Applicable	These regulations impose restrictions on the discharge of pollutants to Publicly Owned Treatment Works (POTW) and mandate that discharges must comply with the local pretreatment program.	Surface water and groundwater dewatering effluent that would be discharged or disposed of at a POTW would be tested to ensure compliance with these regulations. Alternative 1 would comply.
State Regulatory Requirements	New Hampshire Collection, Storage and Transfer Facility Requirements (Env-Wm 2100)	Relevant and Appropriate	These regulations establish design and operating requirements for collection, storage and transfer facilities.	The removal action will be designed and operated in a manner that is compliant with the substantive provisions of these regulations.
	New Hampshire Fugitive Dust Control (Env-A 1002)	Applicable	These regulations require precautions to prevent, abate, and control fugitive dust during specified activities, including excavation, construction, and bulk hauling.	Alternative 1 would comply with this ARAR since fugitive dust emissions would be controlled and monitored during remedial activities.
	New Hampshire Regulated Toxic Air Pollutants (Env-A 1400)	Applicable	These rules establish Ambient Air Limits (AALs) and air quality impact analyses to protect the public from concentrations of pollutants in ambient air that may cause adverse health effects.	Excavation, stockpiling, transportation, and disposal activities would be implemented to prevent air emissions in excess of AALs. If AALs are not met, then corrective action would be taken to reduce emissions as a result of the removal action.

TABLE 11 (cont.)
ACTION-SPECIFIC ARARs AND TBCs
ALTERNATIVE 1 – EXCAVATION AND OFF-SITE DISPOSAL
FINAL ENGINEERING EVALUATION/COST ANALYSIS
MOHAWK TANNERY SITE
NASHUA, NEW HAMPSHIRE
PAGE 2 OF 2

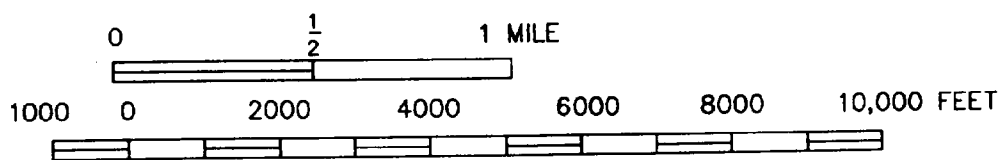
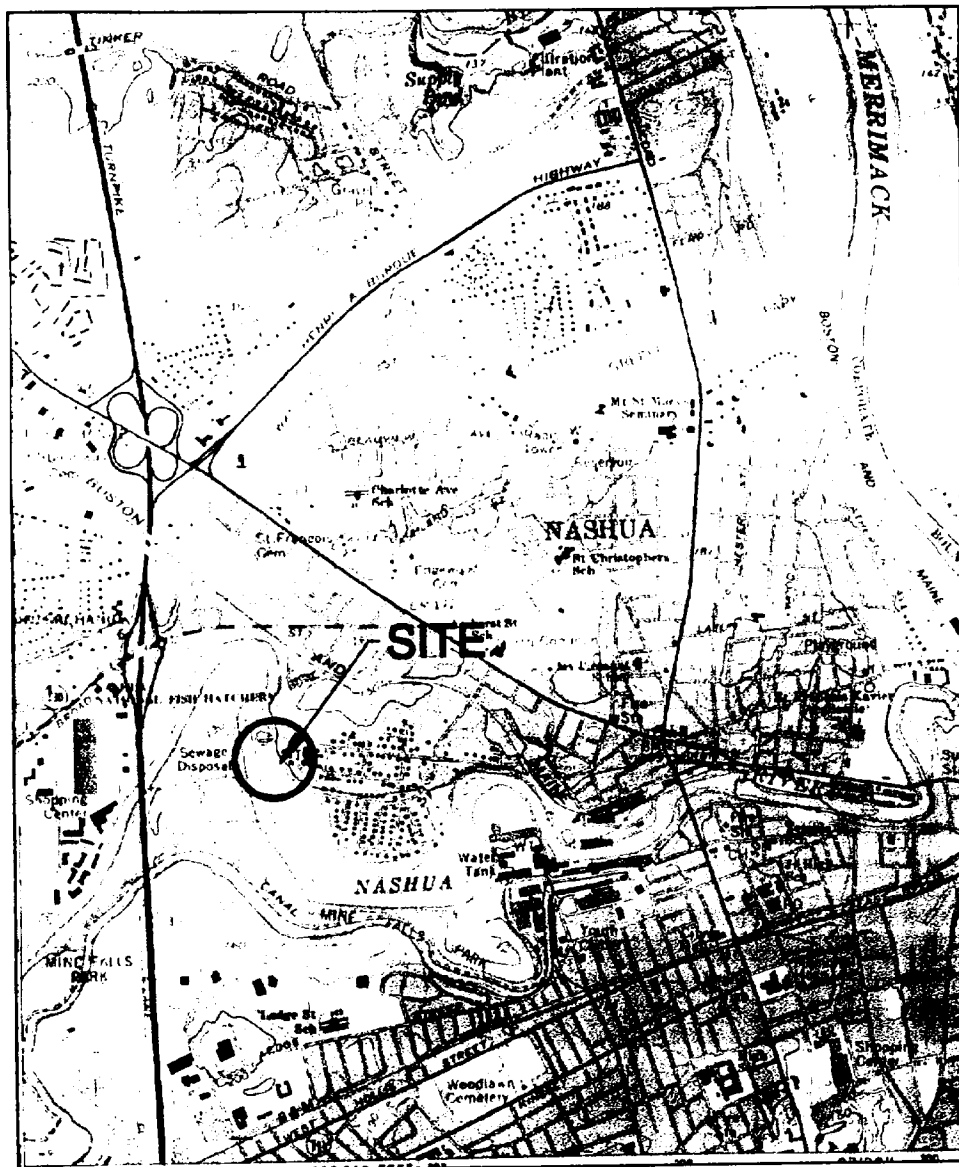
AUTHORITY	REQUIREMENT	STATUS	REQUIREMENT SYNOPSIS	CONSIDERATION FOR ALTERNATIVE 1
State Regulatory Requirements (Cont'd)	Identification and Listing of Hazardous Wastes (Env-Wm 400)	Applicable	These regulations establish the characteristics used to identify solid wastes that are subject to regulation as hazardous waste.	Env-Wm 400, along with 40 CFR 261, would be used to characterize sludge/waste as it is stockpiled during the removal action.
	New Hampshire Requirements for Hazardous Waste Generators (Env-Wm 500)	Applicable*	These regulations outline characterization, recordkeeping, manifesting, labeling, marking and storage requirements for generators of hazardous waste.	If the excavated waste is characterized as hazardous, Alternative 1 will comply with the substantive provisions of these regulations.
	New Hampshire General Requirements for Owners and Operators of Hazardous Waste Facilities (Env-Wm 702)	Relevant and Appropriate*	All hazardous waste treatment and transfer facilities are to meet these environmental, health and design requirements.	If the excavated waste is characterized as hazardous, Alternative 1 will comply with the substantive provisions of these regulations.
	New Hampshire General Operation Requirements (Env-Wm 708)	Relevant and Appropriate*	These rules establish requirements for hazardous waste facility operation.	If the excavated waste is characterized as hazardous, the removal action will be operated in a manner that is compliant with the substantive provisions of these regulations.

* These regulations will be applicable or relevant and appropriate only if the waste is characterized as hazardous.


APPENDIX B

FIGURES

Action Memorandum
Mohawk Tannery Site
Nashua, New Hampshire



NOTE: Base Map from U.S.G.S. Nashua North Quadrangle, New Hampshire, 7.5 Minute Series, 1968, Photorevised 1985

SITE LOCATION			FIGURE 1		
MOHAWK TANNERY SITE			 TETRA TECH NUS, INC.		
NASHUA, NEW HAMPSHIRE					
DRAWN BY:	R.G. DEWSNAP	REV:			0
CHECKED BY:	S. VETERE	DATE:	APRIL, 2002	55 Jonspin Road Wilmington, MA 01887 (978)658-7899	
SCALE:	AS SHOWN	FILE NAME:	\\DWG\4111\1010\FIGURE_1-1.DWG		

